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ENGINEERS' REVIEW

FOR STATIONARY, ELECTRICAL AND MARINE ENGINEERS

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THE MONITOR DUPLEX STEAM PUMP.

It is very seldom that a radical departure in the construction of boiler feed pumps is made. Although improvements may be noted here and there, the same general lines seem to be followed in regard to the construction of the valve gear as well as to other parts. The same may practically be said of simplex pumps.

There are, however, instances where precedents have been ignored and ideas of an entirely different nature adopted as to the construction and operation of the valve gear, at least. And this is the point which most affects the economy of the pump and to it can, in a great measure, be traced its failure or success.

Following is a brief description of the Monitor duplex steam pump built by the Snider-Hughes Co., of Cleveland, Ohio. The movement of the valve gear of this pump is entirely new and has many features of excellence which not only embody all of the good points of the standard or old style duplex pump, but which eliminate many of its objectionable features.

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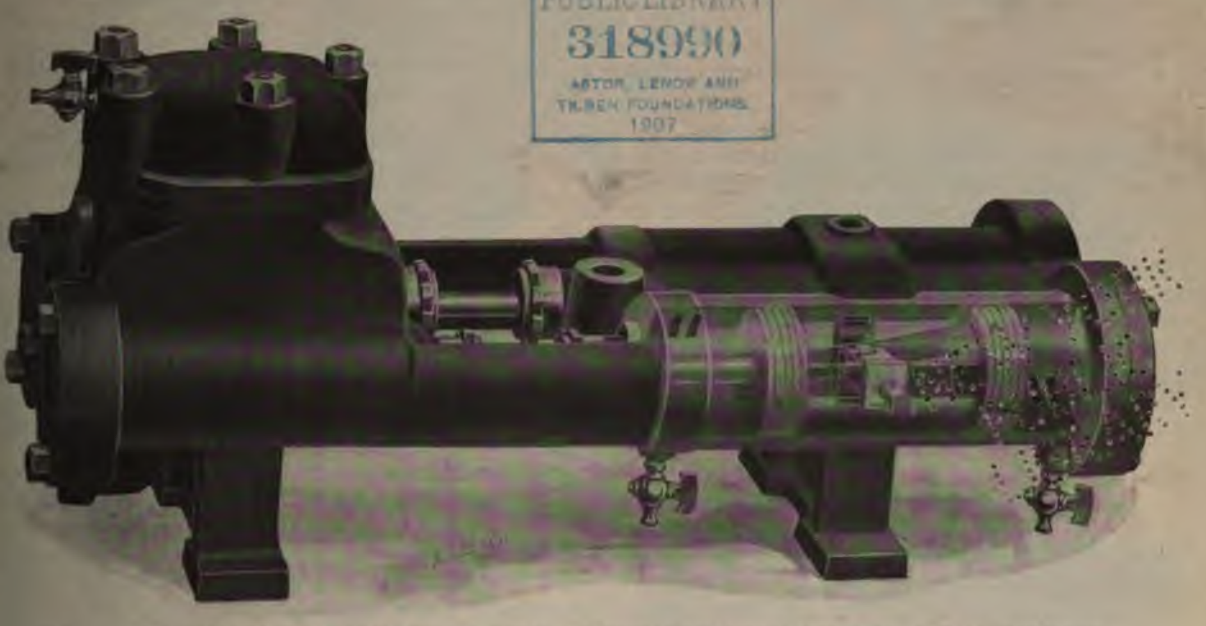


FIG. 1. THE MONITOR DUPLEX STEAM PUMP, SHOWING PHANTOM VIEW OF STEAM CYLINDER.

The mechanism of the steam end of the Monitor pump consists of two steam pistons, two steam valves and two guides, one of each being located in either cylinder. The illustration, Fig. 1, shows a boiler feed pump with one cylinder shown in phantom. Fig. 2, shows the steam pistons with valves and guides in place and Fig. 3, shows the valves, guides and bolts for securing the guides to the sides of the cylinders.

These parts and their operation may be described as follows: The two steam cylinders are placed side by side, each having a steam and an exhaust port at either end. The ports at the end of one cylinder communicate with ports placed horizontally and centrally in the adjacent wall of the other cylinder. The arrangement of these ports is shown in Fig. 4. By this arrangement of ports the steam valve in one cylinder controls the steam supply to the other cylinder.

The steam pistons as shown in Fig. 2, are of the double head type, the heads being connected by a hollow cylindrical body. The pistons are so located that the two heads lie on opposite sides of the central ports, at all times, and the space between the two heads of the pistons serves as a steam chest. Steam enters these spaces through a steam pipe cast across the top of the two cylinders. The steam pistons are prevented from rolling in the cylinders by the guides which work in the straight horizontal slots in the bodies connecting the piston heads. These guides are bolted to the outside walls of the steam cylinders as shown in Fig. 1.

The inner ends of the guides are forked so as to engage the stems of the steam valves, as shown at the right of Fig. 3. This prevents any movement of the valves endways. The spiral slots in the bodies connecting the two heads of the steam pistons are placed face to face next to the adjacent cylinder walls and over the central ports. The steam valve faces are turned to fit the cylinder walls over the central ports. The steam valve stems work in the spiral slots, as shown in the upper engraving of Fig. 2.

The operation may be described by reference to Fig. 1. For convenience, we will call the cylinder, shown in phantom *A*, and the other cylinder *B*. Imagine the steam piston in cylinder *A* to be moving to the right; then as the piston cannot roll, and the steam valve cannot move endways, the valve will be rolled downward by the spiral slot. In this way the upper steam port will be uncovered, and steam will be admitted to the right hand end of the cylinder *B*. At the same time the lower exhaust port will be uncovered, making connection through the D of the steam valve from the left hand end of cylinder *B* to the main exhaust. The piston in cylinder *B* will therefore stroke to the left.

On the reverse stroke in cylinder *A*, the valve will be rolled upward, thereby admitting steam to the left hand and opening the exhaust to the right hand end of cylinder *B*, and the piston in cylinder *B* will stroke to the right.

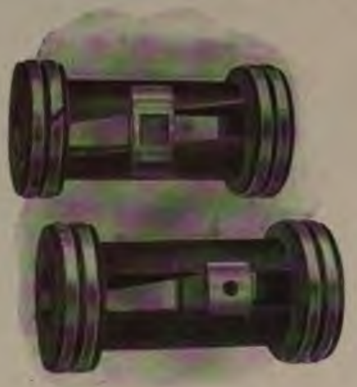


FIG. 2. STEAM PISTON WITH VALVES AND GUIDES IN PLACE.

The piston and valve in cylinder *B* will control the steam supply to cylinder *A* in the same manner. The motion of the steam pistons is transmitted to the water pistons by piston-rods, in the usual manner. The water cylinders are of standard approved design.

The Monitor duplex pump should be a leader, because, in addition to its many other advantages, it is simple. The steam valves are operated directly by the steam pistons, and the entire mechanism consists of but six parts as compared with 23 parts, exclusive of bolts, nuts and pins in the old style duplex pump. By removing the cylinder heads, water-piston nuts, and guide bolts, the entire mechanism of this pump can be removed. This can be done, and the parts all replaced in from 15 to 30 minutes, according to the size of the pump. When the guide bolts are in place, the steam valves are properly set, and no adjustments are necessary.

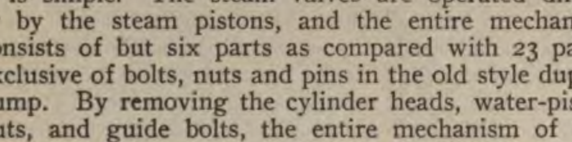


FIG. 3. VALVES, GUIDES AND BOLTS FOR SECURING THE GUIDES.

There are no outside working parts, which in the old style duplex, being necessarily small and exposed to grit and dirt, soon become worn. The working parts all have large bearings, and being in the direct path of the steam, are constantly oiled from the main lubricator. The wear is, therefore, reduced to a minimum.

The motion of the steam valves is continuous throughout the length of stroke, allowing the steam pistons to come to rest gradually at the end of each stroke, thus giving the water valves time to close quietly, and without shock before the return stroke. This prolongs the life of the water valves and insures smooth working at speeds at least 25 per cent in excess of the maximum speed of the old style duplex, it is claimed.

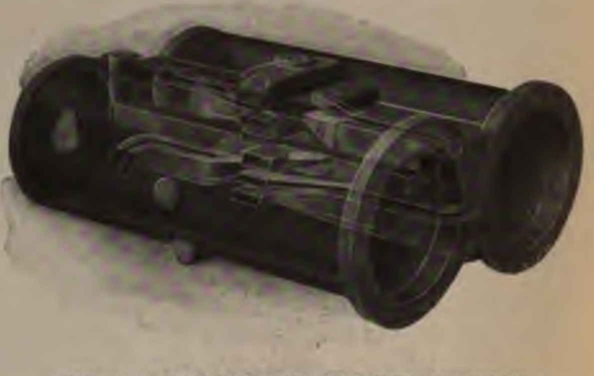


FIG. 4. PHANTOM VIEW OF STEAM PORTS.

The principle of the Monitor duplex is the same as that of the old style, which, in its many years of service, has proved to be the most reliable type of pump. This fact, combined with simplicity and absence of small exposed parts, places this new pump in a class by itself.

An Oil Test.

The following is an interesting report on an oil economy test which was made on a Chandler & Taylor engine. The test was made on an enclosed engine of 150-horsepower capacity, which is driving a 100-kilowatt machine. The engine operates 168 hours continuously, which, of course, is a week's run day and night, and without a shut down. To begin the test, the oil was carefully drawn off, and all reservoirs emptied of oil, and the oil that was then placed in the engine was carefully measured and the engine started on a week's run. At the end of a week all of the oil was drawn off, and again carefully measured and the difference, of course, was that which was consumed or wasted by the engine during this time. All cylinder oil was also carefully measured as it was put into the lubricator. At the end of the week the total cost of oil used by the engine, that is, including both cylinder and lubricating oil, amounted to a fraction less than 75 cents, although the engineer was using a high grade of oil costing 60 cents a gallon.

This figured up on a basis of an ordinary run which would be for 10 hours a day for 300 days in the year, would amount to only $13.20.

We do not know whether this is phenomenal or not, but it is a result which is not obtained by many.

ENGINE ROOM CHATS NO. 18.

BY A GOVERNOR.

"I got onto a pretty good thing yesterday," said Sam after the conversation had flagged for a moment. "Mr. Potter, the politician, stopped in here on a little private business, and made this remark among others, 'that he had found out there was a lot more to the engineering business for a man who knew his business than he had ever thought there was.' I asked him what had brought it to his attention, and he told me about the best thing I have heard in a long time."

"Who's Potter, and what was the story, any how?" asked Steve.

"I supposed everyone knew of Potter. He is one of those politicians who believe in working for the money they make, and being not at all satisfied with political honors, he decided there was money in the refrigerating business. So he proceeded to organize a company of other individuals who had money. The board of directors decided to put the choosing of the boilers into the hands of an engineer who was experienced in such things and who could be depended upon to be honest, even with graft staring him in the face.

"When the Honorable Potter decided to do this, he knew that there would probably be schemes to sell a set of boilers that would turn out to be in the end not as represented by the agents, and he felt considerably relived when he got Jim Barr, engineer of the Consolidated Refrigerating Company, to consent to see to it that the company got what they paid for, and did not get something they were not paying for.

"The specifications for Scotch boilers were written by Barr, and when the bids were received the board of directors were called together to decide which to accept. Of course, Barr was notified to attend, as Potter felt that he wanted some one to lean upon, as his technical knowledge was not above 100 per cent. Barr knew but very few of the members of the board, and when he saw a tall, slim fellow in the room who acted as if he knew it all, he naturally supposed that he was one of the directors of the company.

"One bid after another was opened and the contents read to the members of the board, who nodded their heads every now and again as if to convince the others that each knew what tensile strength, drilled and punched holes and kindred other subjects were. Strange as it may seem, the bids of all of the boiler firms were about the same figure, which goes to show that all figured on making about the same profit, and if one makes more profit than the other, it must be by putting in inferior work and material.

"Great was Barr's surprise when the bids were all in, to hear the long slim chap ask permission to make a bid for the company whom he represented. Of course it was lower than the other bids, and as Potter looked over at Barr he could see astonishment written on every feature. It didn't take Barr long to get on his feet, and the flow of language that came from him would make an election spellbinder feel like taking a back seat.

"'Gentlemen,' said Barr, 'I object to this method of doing business! It is not a square deal to the other boiler manufacturers to let this man come here, and, after hearing bids read which have been submitted to you by other dealers, put in his bid. I want to say in the beginning that I do not get anything out of this, no matter what type of boiler you decide upon in the end, but I want it thoroughly understood that if there is to be any funny business in this deal, I shall wash my hands of the thing and you will be free to get some one else to steer you along the hummicky road you have begun to travel. I am here to see that you get what you ask for, and I will inform you that you won't get it from a man who will undertake to secure a contract in the way this man has attempted to do! That's all.'

"Barr was mad all through, and it didn't take much to see that he meant every word he said. The sales agent didn't have sense enough to know that the best thing he could do was to shut up, and so he brindled up and began to fire a few questions at Barr.

"'What do you mean by saying it will be impossible for these gentlemen to get a square deal from my company through me? I won't stand such talk; I will report this to my company!'

"'Report!' roared Barr. 'Report all you want to! What in thunder do you suppose I care what you report? Your specifications show that you don't intend to do a square thing, or you don't know how to make them out. You don't say a word about how the rivet holes are to be made. You don't say anything about the riveting of seams, whether they are to be lap joint, butt joint, single or double riveted or any other kind of riveting. Your paper don't say whether the material shall be of 50,000 or 60,000 pounds tensile strength. Your boiler, as you have got it, is specified as only a 75-horsepower boiler, and I will prove it to you if you don't know it already!'

"'That boiler, when built according to the specifications, will come up to 100-horsepower, and I will guarantee it!' replied the agent.

"'What does your guarantee amount to?' replied Barr. 'We want it on paper, where we can get at it, and not in verbal form. If you mean what you say, there will be no objection on your part to putting it down in black and white.

"'You say that your boiler will develop 100-horsepower. Well, perhaps it will under some conditions; but, mister, we want a boiler that will develop 100-horsepower under ordinary conditions. It would be a mighty easy matter for you to install your boiler and then send a picked fireman and have picked coal, and under those conditions make your old kettle come up to the rating of a 100-horsepower boiler! What we want is a boiler that will develop 100-horsepower with the ordinary run of coal such as we will have to burn year in and year out, with any old kind of a fireman, and the best of them are none too good.

"'Your boiler won't do it, and I will prove it for the benefit of the gentlemen present. Mr. Potter,' said Barr, 'will you have the secretary read Sharp's specifications as to the shell and heads?' Whereupon the secretary read them. Length of boiler over all, 14 feet 9 inches; thickness of shell, 13-32 inch; thickness of heads, ½-inch.

"'That's right, isn't it?' asked Barr, and upon the agent's assenting, went on. 'That's the kind of a boiler you would try to sell these men as a 100-horsepower boiler to work at a pressure of 125 pounds steam pressure. Now I will give you a few points to take home with you. The length of your boiler should be all of 16 feet, the shell should be 15-32 inches thick, and the head should be ⅝-inch thick. Don't you see the difference?

"'Your specifications call for a grate area of 16 square feet. Now, that stamps the boiler as being below the rating you claim for it. What do you allow as a constant when figuring the horsepower from the grate area, anyway?'

"'Why, four feet per horsepower!' replied Sharp.

"'Well, that is pretty liberal!' replied Barr, in a sarcastic tone. 'According to that, your boiler would have to have a grate area of 400 square feet, in order to bring the boiler rating up to 100-horsepower. In the regular run of things with this type of boiler, the constant is taken as 1-5-foot of grate area to every horsepower, or 1 foot of grate area to every 5-horsepower. Quite a difference, don't you think?

"'Now, suppose you tell the directors what the water evaporation of your boiler will be under working conditions! But before you tell us that, I would like to know what rate of combustion you figure you could get out of your grates per hour per square foot, having an area of 16 square feet?'

"'Between 30 and 35 pounds of coal,' replied Sharp in a nettled tone.

"'I have no doubt at all, gentlemen,' said Barr, as he turned toward the directors, 'but that that boiler will be able to come up to the rating Mr. Sharp claims for it, if he can get that amount of coal consumption out of his grates. The regular rate of combustion is somewhat lower, however, down to about 18 pounds for that matter, and that is the basis used in all calculations with this type of boiler. I know of no reason why his grates should be able to burn almost twice as much coal as any other make, and I know they will not.

"'One little thing I noticed in regard to grates, Mr. Sharp, is that your specifications do not mention them at all. I suppose your boiler requires them?'

"'Oh, we will put that all right,' replied Sharp.

"'What do you have as to the ratio of heating surface to the grate surface?' next asked Barr; 'and what is the ratio of the area of the tubes to the grate surface?'

"'Say, look here! I don't propose to stand this much longer!' replied Sharp. 'I am not supposed to come here and stand an examination, and I want you to distinctly understand that.'

"'If I had my way I would not have allowed you to have been here during this meeting at all, but as long as you are here it seems to me that it is up to you to show these gentlemen that your boiler is what you claim for it. Of course, if you can't do that, I have nothing more to say.'

"'Well, I don't think I understand what you mean by the ratio between the heating surface and the grate surface,' said Sharp.

"'I mean how many feet of heating surface in the boiler is there to the grate surface; that is, how does the heating surface of the boiler compare to the grate surface,' replied Barr.

"'Oh, I don't understand all these new fangled terms that you are using; I am more used to the practical part of the business.'

"'Well, perhaps you are, but you don't show it,' said Barr. 'Now about the evaporation; what do you think you could make your boiler do?' Barr next asked.

"'The boiler I have will easily evaporate 41,000 pounds of water. The number of tubes show that it will evaporate more water than the other boiler that has been bid upon.'

"'That settles it!' growled Barr. 'If your boiler will evaporate 41,000 pounds of water per hour, I will throw up the sponge and admit that your boiler takes the cake. I'll tell you, gentlemen,' said he, 'that the average rate of evaporation is below 34 pounds per horsepower and the standard is figured as 34½ pounds of water evaporated per hour from feedwater at a temperature of 212 degrees F. into steam at the same temperature. A more conservative estimate as to the evaporation of that boiler of Sharp's would be as low as 2,600 pounds of water under the same conditions. As for the tubes making a difference, I will admit that I do not know what point Sharp is driving at.'

"'It is just this: In my boiler there are 65, 3-inch tubes, while in the other boilers the best that I noticed was 56 3½-inch tubes. If that don't give my boiler a greater heating surface than any of the others, I would like to know what does?' and the agent's tone had a ring of confidence.

"'How is that, Barr?' asked Potter. 'That looks as if the other boilers were not up on tube surface, don't it?'

"'Yes, I guess I have you there!' joined in the agent with considerable good nature.

"'Got me to get!' snapped Barr; 'those other boilers have more heating surface in the tubes than yours has.'

"'Do you mean to tell these gentlemen and myself that there is more surface in 56 3½-inch tubes than there is in 65 3-inch tubes? Why, man, what are you talking about?'

"'That's right!' replied Barr; 'go it while you have a chance! You act a good deal like a young turkey gobbler the day after Thanksgiving; mighty glad to be alive. Now there is more heating surface in 56 3½-inch tubes than in 65 3-inch tubes;' and Barr grabbed a piece of paper and began to figure and talk at the same time. 'This calculation,' said he, 'is taken on a basis of 15 feet as the length of the tubes, as that is the nearest in whole numbers to your boiler. Your tubes have 110,271 square inches in them and 56 3½-inch tubes of the same length would have 110,835 square inches or a difference of 564 square inches in favor of the 3½-inch tubes.

"'Now, gentlemen,' went on Barr, 'it is evident to me that this representative does not understand his business, and I would suggest that these bids be thrown out, and new ones considered.'

"The thing was put to a vote and Barr's suggestion was adopted, and that is the way the matter stands today."

"Shure, if they had had any sinse at all," said Dan, "they would have come over here, and Sam would have put things all roight; but, begorry, that Barr was up ter snuff all roight!"

An explosion of natural gas in the flouring mill located in Decatur, Ind., seriously burned three employes and caused a fire which destroyed the mill, entailing a loss estimated at $40,000, and 10,000 bushels of grain were consumed.

INDICATOR CARDS.

ADMISSION LINES.

By W. H. Vincent.

It is not only necessary to know the general outlines of the different types of cards, but it is also necessary to understand the meaning of the different quirks and turns that are met with in indicator practice, as each line has a distinct bearing on the action of the indicator, the steam in the cylinder and the valves.

In taking up the different lines it will be as well to begin with the admission line, of which several different effects are shown in the illustrations. One end of a diagram is shown at *A*, Fig. 1, which includes the compression line and the admission line. As will be seen the pressure runs up suddenly to full pressure. This line is secured by adjusting the steam valves so they open fully before the piston begins its stroke, or begins to move away from the cylinder head. This involves the question of lead, the amount of which, the size of the engine and the speed at which it is to run, determine to a great extent.

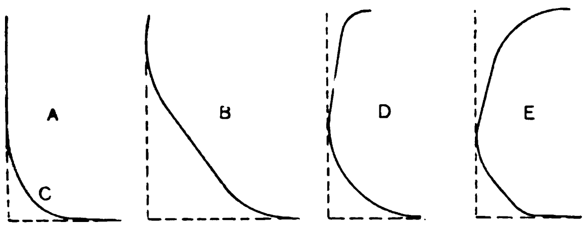


FIG. 1. ADMISSION LINES.

Lead should be as little as possible, at the same time allowing the admission line to be perpendicular. Sometimes an engine is given enough lead to admit steam to the cylinder a little before the piston reaches the end of the stroke which gives an admission line something like *B*. This practice is upheld by some engineers and condemned by others. The question is this: Is it better to cushion the piston by live steam from the boiler, and thus fill a space that might have been filled with exhaust steam, or to adjust the valves so that the steam having already done work may do the work of cushioning the piston? The latter is the better way without doubt and a practice that is followed by the average engineer.

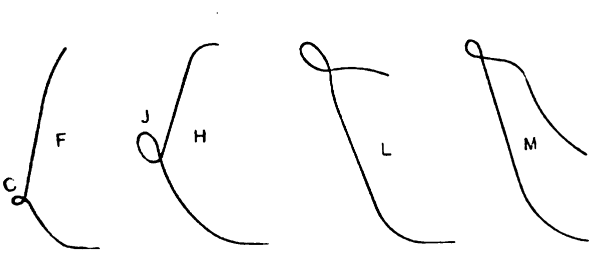


FIG. 2. ADMISSION AND COMPRESSION LINES.

In diagram *A* the compression line shown at *C* is such as may be obtained by adjusting the exhaust valves to cushion the exhaust steam, which should not cause the compression line to extend higher than 2-3 the height of the diagram.

D and *E* show that the valves open late, so late that the piston had started on its return stroke before the valve opened at all.

F Fig 2, is a very common admission line and is caused by the compression running up to the point *C*, and falling away again because the piston starts before the valve opens.

H is a more aggravated form of the same trouble.

The loop *J* may take all kinds of forms according to the compression, admission, piston speed and valve opening, and may be formed by excessive compression as shown at *L*. Such a loop is usually found on cards taken from single valve high speed engines with shaft governors, when compression is increased as the load diminishes. In *L* the compression line extends above the steam pressure in the boiler but falls when the valve opens. Light load on an engine is shown in the diagram *M* but the compression is very heavy.

At Fig. 3 there is considerable compression and a loop is formed at the point *O*. This may be caused by the condensation of the steam in the cylinder, thus causing a drop in the pressure, but it more likely indicates a leak, due to a valve lifting from its seat, or from some other cause.

P shows that the exhaust valve does not close in time to cause any compression whatever, and any engine running in that condition would undoubtedly have a disagreeable pounding, because there would be no compression to gently bring the reciprocating parts to rest. At *R*.the exhaust valve does not close until a point is reached on the return stroke allowing the first of the incoming steam to blow through into the exhaust passage. In diagram *T*, the exhaust valve does not close for compression or until the piston is well on the forward stroke, so that the live steam is blowing right through the valves and connot keep the pressure up. This might be caused by an eccentric slipping which would make the valve motion late and the back pressure line *U* to continue straight to the end of the stroke, compression being entirely out of the question with the valve in such a position. When the piston began the return stroke the steam valve had not opened, but the exhaust valve had closed and the pressure run down to the point *V*, the direction of the pencil movement being traced by the arrow. At *V* the steam was admitted suddenly and the admission line ran up, leaving the loop as shown.

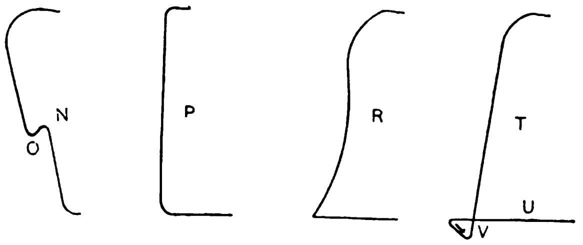


FIG. 3. COMPRESSION LINES DUE TO FAULTY VALVE SETTING.

The sharp point at *X* on the diagram *W*, Fig. 4, indicates too much lead. There is no advantage in having so much lead and the engine will run better and smoother if the line were rounded a trifle as shown by the dotted line at *Y*.

At *A* the point of release is shown. The loop *B* indicates a very early cutoff, causing so much expansion that the pressure drops below the atmospheric pressure before the exhaust valve opens. This shows that the engine is working against itself and the remedy is to drop the steam pressure. With diagram *C* the release takes place at *D*; if it had taken place later on at *E* the diagram would have taken the form shown by the dotted lines, and a small area would have been saved which would have added to the mean effective pressure of the card.

A proper release line is shown in diagram *F*, in which the release occurs early enough to allow the pressure to fall nearly to the line of counterpressure by the time the end of the stroke is reached. A diagram like that shown at *G* would be the result, if the release were delayed until the end of the stroke. It would be advisable to retain the full area if it were possible to carry the pressure to the end of the stroke, but as it is not, because some of the area must be lost in expelling the exhaust steam, it is better to retain the area as at *F* than at *G*. It is also preferable to allow the pressure to diminish as in the diagram *F* than to allow the steam to keep on doing work, because there must be a point where the piston has got to come to a stop and reverse its travel, and to do this smoothly compression is applied to the other side of the piston. It is evident that there is no object in carrying steam pressure to the end of the stroke as would be the case in diagram *G*. By allowing the pressure to fall off as at *F* we allow the release to assist, rather than oppose, the compression in bringing the moving parts to rest, and at the same time remove the back pressure that would be present if the release were as shown by the dotted line on the diagram *F*. By removing this back pressure the piston encounters less resistance in getting started on its return stroke.

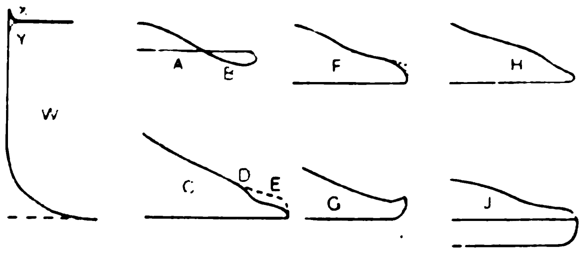


FIG. 4. RELEASE LINES.

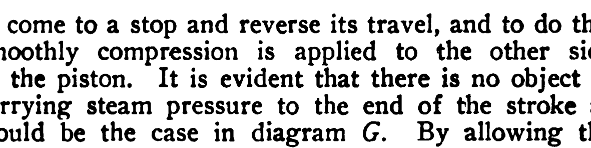


FIG. 5. RELEASE AND STEAM LINES.

Quite frequently on the four-valve type of engine a compromise is made something like the diagram *H*. When an engine is operated condensing the advantage of an early release is apparent, as is shown by the diagram *J*, where it will be seen that a prompt realization of the vacuum is obtained and the largest part of the load is thrown on the condenser. If the exhaust valves were late the retarding action of the steam in leaving the cylinder would result in the loss of a large area of the vacuum portion of the diagram as outlined by the dotted lines of diagram *K*. Under these conditions there would be a demand for a later cutoff which means a greater steam consumption. This is because when the cutoff is late more steam is admitted and of course has to be expelled. The release line will then have a different appearance than any of the other release lines, an illustration of which is shown in the diagram *L*, Fig. 5.

The steam line of the indicator card has as many variations as has the admission line. This line tells what percentage of the boiler pressure is utilized in the cylinder and how well the pressure has been maintained up to the point of cutoff. Very few steam lines will show up as well as that produced in the diagram *M*. If the steam line of a diagram does not come up to the boiler pressure, the difference may be determined by laying on the diagram a scale the same as that of the spring with which the diagram was taken. There are a large number of engines that do not get steam at anywhere near the boiler pressure that they ought, but with short connections, ample passages and low piston speed a very large percentage can be realized. If the drop in the steam pressure is caused by small steam pipes or high speed the diagram will appear like that of *O*, Fig 5, which shows that the steam line has fallen away. The difference between the beginning of the stroke and the point of cutoff is in this case using a 40 scale, about 15 pounds, which is altogether too much. One thing to remember is that steam should not flow faster than 8,000 feet per minute, therefore the cross section of steam pipe and passages are to the sectional area of the cylinder as the piston speed is to 8,000. If the piston speed is 550 feet per minute, the area of the pipe should be $\frac{550}{8000}$ of the cylinder area.

The diagram *P*, Fig. 5, is caused by a small steam pipe and a large steam chest. The diagram *R* in the same figure is such as is produced by a very light load, the load being so light that there is no steam line at all to speak of. This is because the valve closes as soon as it opens and the steam in the clearance space expanding down, produces the card as shown. Many other diagrams might be given showing the different steam lines that are obtained under changing conditions, such as working steam full stroke, overload, fluctuating load, etc., but enough has been given to give a general idea as to what is to be expected under ordinary conditions.

To find the horsepower necessary to elevate water to a given height, multiply the weight of the water elevated per minute in pounds, by the height in feet, and divide the product by 33,000. An allowance should be added for water friction, and a further allowance for loss in steam cylinder, say from 20 to 30 per cent.

THE PARABLE OF AN ENGINEER.

BY JOHN H. RYAN.

rasmuch, as many have taken in hand to set forth der, a narrative of things that have occurred gst us, it seemeth good to me, an eye-witness, to that thou mayest know the verity of these words.

e tannery of Fallon was like unto a three-ring s in its vastness. The size thereof was not always

d in a small dungeon there still struggles and s a four-valve engine, a captive from the land Fitchburg.

cording to the custom of the country, an adjoin- ungeon was inhabited by an unruly captive of the tube type, whose bleary front showed the brand in.

d the tanner looked amongst his slaves, and dis- ing an one with greasy habiliments and with black e corners of his nose ordered that he be brought e him.

en the slave entered the presence, he was ex- d in these words:

y recompense will be 16 pieces of silver, but hall be taken from thee if thou dost kick against oad.

ive these captives to your charge and it is re- d of thee to fill the one with water and to build eplenish the fire and to keep it everlasting.

d oftentimes thou must remove the ashes and in fuel.

ou shalt also oil the engine and pound oakum in aky seams of the vats and also thou wilt repair achinery even unto the fifth and sixth story.

d furthermore, I command thee to arise before ightness of the sun and to have these things in ess when the dial marketh the seventh hour.

e slave bowed his head and his back to his mas- will and he prophesieth that wonderful things come to pass.

ily, the way of the tanner is hard, for an oil passing that way deceiveth him and sold him oil red from animals, instead of that which comes out of the earth.

smuch as the boiler was coated with grease from eating system, the slave after much exhortation revailed upon to put soda into the feedwater.

w it came to pass, at this time, that a shirt boiling was established next door.

d a beautiful hand-maiden exercised her wiles harmed the poor slave! Selah.

w at the appointed time the slave was hanging f the fourth-story window saying to the maiden the alley:

thou not far from me, for better is one day in urts above thousands."

unearthly pounding and roaring as of many recalled the slave back to earth.

d when the storm had abated he found that the nd oil had been making soft soap in the boiler.

boiler was philanthropical and it passed a re of suds, that it had no use for, over to its fel- ptive in the next dungeon.

v this unexpected kindness so exhilerated the e that it burst its bonds, even unto the bolts confined its head and Samson was himself

When the reaction came, the slave found that his charge had a broken crank, a bent connecting-rod, a broken crosshead and an open ended cylinder.

Verily, there was weeping and gnashing of teeth from the hundred men laying idle for two weeks.

And the slave to all défamation replied in a loud voice:—

"Is it meet that I should be examining the skin of a heifer on the fourth floor and yet know when the boiler has had a liquid sufficiency?"

And to the doubtful ones on the outside, with an optical closure, he said:—

"Know you me not as a truthful man?"

The tanner was wroth and he said: "Woe is me. I must have another slave to attend the boiler so that the work in my place may not be so discontinued again."

There was rejoicing amongst the laborers when the iron monster was once more harnessed to its work.

And their cups were filled to overflowing when the herald announced the nuptials of the hand-maiden and the slave.

For now the slave would stick closer than a brother to his charge and all would run as smoothly as a gentle zephyr through the waving maize.

And it was so.

Condensed History of the Steam Engine.

Papin, of France, was the first (in 1690) to operate a piston by steam, which acted only on one side of the piston. He also invented the safety valve. He was born in 1650, died 1710. Savery, 1697, first employed steam power in doing useful work. His piston, like Papin's, took steam on one side only, the pressure of the atmosphere being admitted to the other side. James Watt was the first to make the complete steam engine, or the existing forms in which steam acts on both sides of the piston. He also made the steam condenser, the governor, the walking-beam, applied the flywheel, and nearly all the parts of the modern engine. He was born in 1736, died 1819. He made a rotary steam engine in 1782, and patented a locomotive in 1784. In 1804 Trevithick and Vivian operated a locomotive which traveled five miles an hour, with a load of ten tons. Cook, in 1808, used fixed engines and ropes to draw railway cars. Blatchett and Hedley, in 1813, discovered that smooth locomotive wheels might be used on railways, instead of toothed wheels and toothed rails, before required. George Stevenson, 1825, made railway locomotion successful by adapting the locomotive to variable speeds and loads by means of the blastpipe, and by introducing the tubular boiler, which latter was suggested to him and invented by Booth, 1829. The first competitive trial of locomotives on the Liverpool and Manchester Railway took place Oct. 6, 1829, which established the superiority of Stevenson's locomotives, and inaugurated the art of railway communication.

The first steamboat actually employed in business was a small vessel built by John Fitch, of Pennsylvania, 1790, worked on the Delaware; speed, seven and one-half miles per hour. Robert Fulton's steamboat, the "Claremont," made her first trip from New York to Albany August, 1807; speed, five miles per hour. The first steam vessel to cross the Atlantic was the "Savannah," in 1819, from Savannah to Liverpool, in 26 days. In 1838 the "Sirius" arrived at New York, 17 days from London, and the "Great Western," 17 days from Bristol.

In 1814 a locomotive built by Stevenson, in England, traveled at the rate of but six miles an hour. On September 14, 1891, a train on the New York Central and Hudson River Railroad covered the distance from the Grand Central Depot to East Buffalo — 436 miles — in 426 minutes. Actual running time, 61.44 miles per hour; weight of train, 230 tons.

The largest locomotive in the world is No. 151, in service on the P. B. & E. R. R. It weighs 225,000 pounds on the drivers alone, and was built by the American Locomotive Works, Pittsburg, Pa.

The steamer Victorian building at Belfast for the Allan Line will sail on her maiden voyage to Montreal in a few weeks. She will be the first passenger steamer to be equipped with turbines to cross the Atlantic ocean.— *Exchange.*

ELECTRICITY FOR ENGINEERS.

MOTOR OVERLOAD STARTERS.

BY JOS. VAN ALLEN.

When a motor is placed in a shop or elsewhere, it is generally with the understanding that it has about so much work to perform and will therefore do so many horsepower of work. In about 75 per cent of the establishments the motor is hardly started before additional work is thrown on and in a short time the motor is laboring under a heavy load.

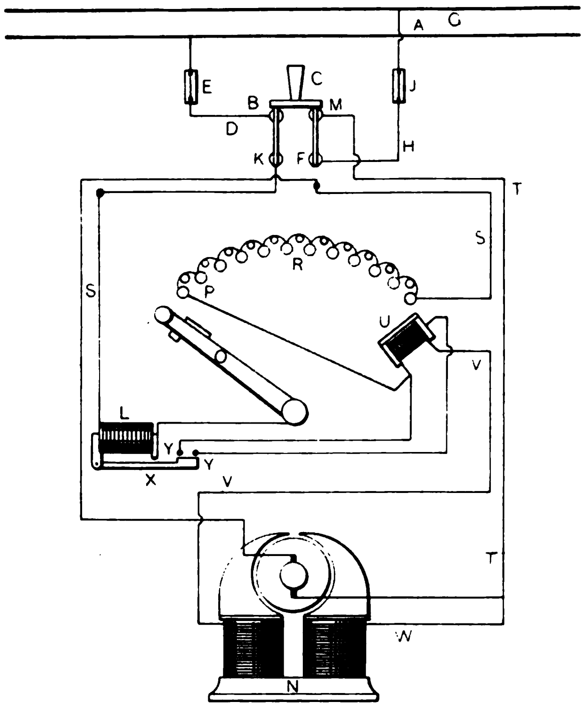


FIG. 1. OVERLOAD MOTOR STARTER.

When a motor is working under a heavy load, if for any cause the load is suddenly increased, the motor will receive an increase in the current. To guard against accident due to this cause, a circuit breaker is wired in on the line.

The circuit breaker is a safety device, which automatically opens a circuit when the current exceeds a given value. The action is this: When the excessive current sets up a magnetic force strong enough to overcome the power of a spring holding two contact pieces together, their contact is broken. The same principle is applied to a device known as the overload motor starter. The connections of one type are shown in Fig. 1. As the figure shows the main line *A* is connected to the terminal *B* of the switch *C* by the wire and fuse block *D* and *E*. The terminal *F* is connected to the line wire *G* by means of the wire *H* and the fuse block *J*. A wire running from the terminal *K* connects with the magnet *L*, while from the switch terminal *M* a wire connects with the lower brush of the motor *N*.

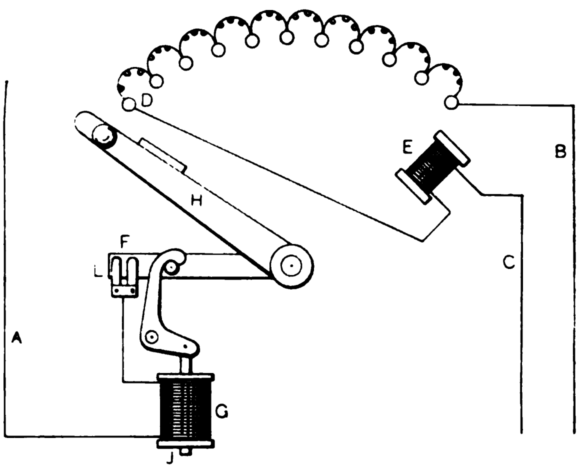


FIG. 2. ANOTHER TYPE OF OVERLOAD MOTOR STARTER.

The entire current from the main line runs through the magnet *L* as it passes on through the motor. The starting switch *O* is connected to the magnet *L* as shown, which, when moved over to the contact *P*, continues on through the resistance *R*, around to the top brush of the motor through the wire *S*. The current then passes through the motor armature to the wire *T*, through the switch C. and on the main wire *G*.

From the contact *P* of the resistance contact a wire is run to the magnet *U* and then through the wire *V* to the left-hand field winding of the motor *N*, thence through the right-hand field and on to the wire *T* through the wire *W*.

The wiring so far has been the same as the motor starter taken up in the last paper, the office of the magnet *U* being the same, *i. e.*, it holds the lever *O* up against the magnet with a force stronger than the spring which is connected to the lever *O* and tends to pull the lever back into the starting position. The magnet *L* is an addition, however, and as has already been said, carries the whole current. Consequently when the current increases, its strength increases. When this is enough to lift the armature *X*, a connection is made with the contacts *Y Y*, and the magnet *U* is short-circuited and loses its strength, which permits the spring to swing the lever *O* back into the starting position, and so stops the motor. The office of the magnet *L* is to shut off the current from *U* when the current passing through the motor is too strong for the motor or strong enough to lift the armature *X*.

The magnet *L* is of course adjusted to operate with currents of different voltage.

When a motor is provided with such a starter the main switch *C* is opened, and then, as soon as the current through the magnet ceases, the magnet *C* loses its strength and the spring swings the lever back to the starting position. With the overload starter it is possible to stop the motor by simply lifting the armature *X* and short-circuiting the coil *U*. This is a practice that should not be followed because the circuit connection between the lever *O* and the contact *P* is broken, while the full current is passing, which causes considerable sparking at the contact *P*. This will, of course, get so rough in time that it will prevent the switch from working freely.

Another type of overload magnet is shown in Fig. 2, the connections to the motor being the same, but the action and make of the magnet is different. The wire *A* connects to the main wire of the line through the main switch and fuse block. The wire *B* connects to the top brush of the motor, and the wire *C* runs to the left-hand field of the motor, the resistance terminal *D* being connected to the coil magnet *E* in the usual way. The action of this overload magnet is as follows: The end of the lever *F* rests upon a contact piece which is connected to the coil *G*, so that the current passes from *D*, when the motor is running, through the lever *H*, through *F* to the magnet and on to the line through *A*.

The magnet *G* is of the solenoid type and tends to lift the plunger *J*. When the main current becomes strong enough the plunger is raised and in striking the lever throws the catch out of engagement with a pin on the lever *F*, which immediately flies up, due to the tension of a spring. This breaks the contact at *L* between the magnet and the lever *H* and so opens the circuit through the motor armature. A device is used and so set as to cause the plunger *J* to lift with different strengths of current.

It is as well to state now as at any other time that it is advisable to use the fuse blocks between the main switch and the line wires, because they afford additional protection and act in an altogether different way from the overload magnet. The overload magnet responds to a sudden increase in current, if only for a short time and so gives complete protection to the motor. The fuse, however, will not respond to the sudden rushes of current because it requires time to heat the fuse wire to a point of melting, therefore a continuous excess current will, if continued, melt the fuse.

The fuses are made to melt with a comparatively small current, and the overload magnet is set so as to act with a considerably stronger current. The fuse protects against an increase in current due to a continuous overload, while the overload magnet will protect the motor against a sudden overload of greater magnitude. For large motors a circuit breaker, mentioned at the beginning of this article, is used which acts in the same manner as the overload magnet in the motor starters already taken up.

On one square foot of grate can be burned on an average from 10 to 12 pounds of hard coal, or 18 to 20 pounds soft coal, per hour, with natural draft. With forced draft nearly double this amount can be burned.

REPRESENTATIVE MEN FROM THE ENGINE ROOM.

The subject of this sketch, Mr. H. E. Huntington, was born at Valparaiso, Ind., June 1st, 1868.

His first experience with steam boilers and engines was in 1884. Although quite young he accepted a position with the Tutill Spring Co., at Hammond, Ind., as fireman. He kept this position until 1887. He then moved to Omaha, Neb., to accept a position with a refining company. His next position was with Armour & Co. of Chicago, Ill., in 1890, taking charge of the machinery of the fertilizer department, and in 1892 was promoted to the position of assistant engineer in charge of their largest refrigerating plant, where he remained until 1894. Mr. Huntington next accepted a position with Swift Co., also of Chicago, as engineer in charge of their refrigerating plant No. 1, remaining there until 1897, when he went to the Continental Packing & Provision Co., Chicago. In 1898 he removed to Steubenville, Ohio, to accept a position as chief engineer of Kochnline Bros'. Ice & Cold Storage Co. While with this company he installed an ice skating rink, which proved a successful investment. This plant changed hands in 1900 and Mr. Huntington, being enthusiastic and desiring much experience, accepted a position with the Riverside furnace of the National Tube Co., as master mechanic, but six months was all he desired of furnace work. He then removed to Huntington, W. Va., to accept his present position, which is with the Consumers' Ice & Cold Storage Co., as chief engineer.

H. E. HUNTINGTON.

Mr. Huntington is an expert indicator operator. He has the finest indicating outfit which money can buy, and has indicated nearly every engine in his section of the country.

THE IDEA-EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

A Correction.

On page 58 of the February issue an error was made in the sketch shown in Fig. 2. The base line should have been curved the same as in Fig. 1, in order to fit the circle of the commutator.—Editor.

Synchronizing Alternators.

Editor of the Engineers' Review:

The article in a recent Review about synchronizing alternators, brings to mind a device we have for synchronizing alternators driven by Corliss engines.

I do not claim anything new or original in this device, yet it may be of use to some engineer who wants to synchronize, and does not know just how to go about it.

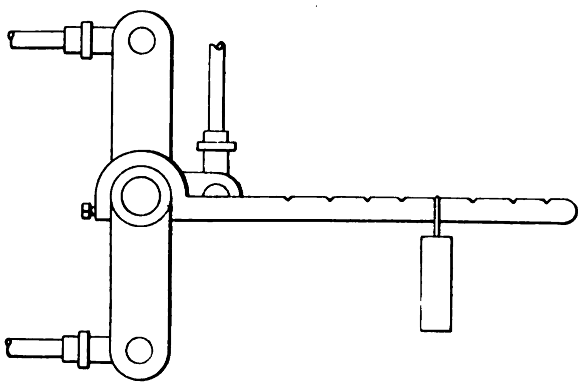


FIG. 1. WEIGHT ARM IN POSITION.

I had always thought that connecting alternators in parallel was something to be dreaded and went about it with fear and trembling. Our engines were of the same make and type, although they were of different size and speed and having heard of so many large stations having difficulties, I was afraid they would not stay together, owing to the different speeds and crank throw.

One is a 12 x 30-inch running 100 revolutions and the other 16 x 36-inch cylinder running 85 revolutions a minute. I find, however, there is no trouble as long as the generators are running at the same speed, and you have some positive way of changing the speed of the engines in synchronizing. I send three sketches showing how the governors are arranged for regulating the speed while running.

On the 12 x 20-inch engine I have the rig shown in Fig. 1. It is a light iron bar about 16 inches long with notches an inch apart and a hollow weight made of bicycle tubing filled with shot. This engine we use in the day time and for small loads late at night.

Fig. 2 shows the rig used on the 16 x 36-inch engine and is somewhat different from the other. It is used in making extra fine adjustments of speed, and was made from material found in the junk pile. The bar is the feed rod taken from on old arc lamp, screwed into the rocker arm of the governor. Arranged to slide along on this is the gear train taken from the same lamp, to which is attached a hollow weight made from a small tin can. Into this can we put shot to get the desired weight. *A* is a gear and pinion, the pinion meshing with the rack teeth on the rod. *B* is a wheel and pinion, the pinion meshing with gear *A*. *C* is a steel spring attached to the frame and pressing on *B* to act as a brake to hold it in any position in which it may be left.

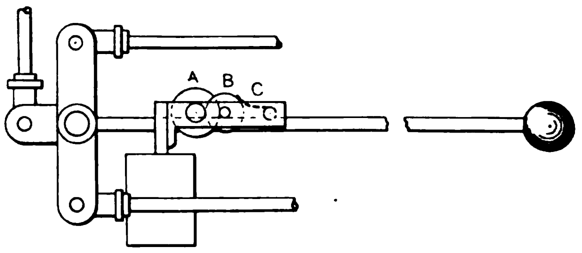


FIG. 2. ANOTHER SPEED REGULATOR.

Fig. 3 is a plain view showing the arrangement of the different parts. By having the weight arranged in this manner it is possible to make a micrometer adjustment.

Our alternators are 60 cycle, running 720 revolutions a minute and I have had the speed so near to synchronism that there would be but one pulsation of the lamps in 30 seconds, which gave ample time for any ordinary man to throw the switch, although I do not usually try to get it finer than one pulsation in 10 seconds. It will be noticed by examining the illustrations that moving out the weight in Fig. 1, increases the speed of the 12 x 30-inch engine, while moving out that in Fig. 2, decreases the speed of the 16 x 36 engine, thus giving a very wide range of speed regulation which is found to be necessary in coupling one set running empty with the other loaded. If the difference in speed between the two is so great that they will not come together, we transfer some of the load from the loaded machine to the other although this is hardly ever necessary. We do not try to govern the speed by the throttle in synchronizing, as the adjustable governor is much more to be preferred.

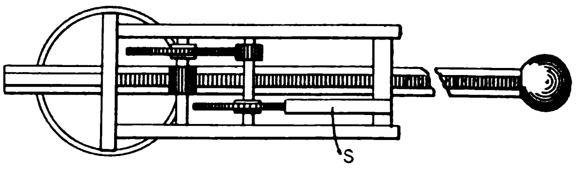


FIG. 3. PLAN VIEW OF REGULATING DEVICE.

In throwing them together we usually make a coarse adjustment with Fig. 1, and then bring it down fine with Fig. 2.

ly we attempted to run the machines sepa-
divide the circuits between them, but found
ible to always divide the load so as to give
hine its proper share and to change a circuit
machine to the other; using a double throw
was necessary to make a flicker in the lights
ised every one to begin asking questions and
know what made the lights go out and on
ht.

rly always synchronize in changing machines
found how easy it is, and we can change any
f times each evening and none of the custom-
the difference.

f the wise ones imagine one machine makes
ts than the other and by transferring in this
don't know which machine is running and
ppy.

sferring the load from one machine to the
er getting them in parallel we decrease the
ne and increase the other, each one about the
unt so as to keep the voltage constant. Soon
ave all the load and the other none, then the
aving no load is open circuited at the switch
its engine shut down. In starting a second
hese tactics are reversed until each has its
the load.

y intention to replace the weight on Fig. 2
all direct current reversable motor geared to
vith a worm and taking off the brake *C* have
so wired that it can be controlled from the
ard, taking current from the exciter circuit.
eme works all right you may hear from me
this subject.

I. M. Reeve.

Familiarity Breeds Contempt.

the Engineers' Review:

torial "High and Low Water Alarms" in a
e of the Engineers' Review speaks volumes.
times one reads it the more good meat is
still no bone appears.

is no doubt whatever that when one reads
explosion of a boiler or boilers, nine cases
ery ten the damaged boiler was rigged up
of the latest and best safety appliances on
t, especially with safety water columns, etc.,
se a boiler or an engine is trimmed out with
afeties does not prevent it from exploding or
om injury.

hese appliances are all right, the attendants
That is the rub. Take the phrase, "Necessity
ther of invention," and "familiarity breeds
These little phrases hit nearly all of us.
get so used to a thing that we pay hardly
attention to it. Then along comes the con-
—a smashup or a blowup, or both, and gen-
e lives go along with it. Here is where the
et it in the neck as well as the guilty; both
r.

1885 when I was just starting in, the water
gage cocks were something similar to what
the Mississippi gage cock. The operation
f pushing a stem against the pressure. This
ne, so by laying a stick against the "pushing
continuous jet of steam came out and when-
showed up, the pump was stopped. This
upper cock.

The next thing we came across was the glass water gage. By watching and depending on the glass entirely, the gage cocks were never used, except when the glass broke. The next thing, out came a water column with gage cocks, glass gage and a whistle. Then two whistles, one for high and one for low water alarms. Everything was dropped then and all dependence put in the whistle. Next we had a boiler explosion, cause unknown, etc.

Firemen don't like to be called down by their superiors, and when the alarm on the column goes off the boss hears it. He knows the limit is reached in the boiler house, either too high or too low. The fireman hates to hear it himself so he then either pays more attention to the alarm, or neglects it more than ever. Either way makes it inconvenient or unhandy for the fireman.

I stepped into the boiler house one day at a near by plant and noticed everything seemed to appear up to date as far as the "trimmings" were concerned. The safety water column was fixed so as to blow at low water, which was exactly one gage in this instance. The boilers were running light when I stepped in and Mr. Fireman was taking things easy. The boilers were popping off at 110 pounds and the furnace doors standing wide open. All at once without a signal to the fireman a heavy load was put on, calling for all the steam the two boilers could generate. The fireman jumped up and began to heave in coal. When he got through this 16-bushel task the steam had dropped to 85 pounds and the water showed about $\frac{1}{2}$-inch in the glass and the steam kept on falling as well as the water. To put the injector on would make matters worse so far as pressure was concerned. I looked up and saw a piece of gunny sack tied on top of the water column and it looked as if the steam was leaking through. The fireman told me he tied the sack on the whistle to keep the thing from making a racket. I would not know what to call this class of deception.

Now had this whistle been free to work, it would have notified the attendant long before the load came on, that he was neglecting his work. This is one of the worst features a safety water column has, *viz.*, it can be doctored to suit the whims of the attendant, etc. You fool with or try to retard the workings of anything mechanical in the automatic line and you will automatically get the worst of it every time.

Gage cocks, water glasses, water columns, both safety and otherwise, are good things and a necessity, but if you neglect them or get careless they are practically useless.

F. C. H.

Alarm Water Columns.

Editor of the Engineers' Review:

From the editorial in a recent issue it seems that Prof. Cooley has a wide reputation as a mechanical engineer and no doubt he thinks he knows what he is talking about. Now is the safety water column less safe than the nonsafety column, or is any column of any use when not properly cared for? Is not a column without a whistle just as liable to clog up as the one with a whistle? I fail to see what column will be safe if the engineer fails to blow it out as often as is necessary.

So far as I can see the safety column is O. K. and makes an engineer watch his water more closely than as if there were no whistle. For one thing, it keeps careless men from getting water up in the smokestack, or as the boys say, 4 gages in the smokestack, and also from getting too low. I have had experience with the safety and nonsafety column and I think I had to give one as much blowing out as the other. W. E. S.

High and Low Water Alarms.

Editor of the Engineers' Review:

Seeing a statement made by Prof. M. E. Cooley in the December issue of the Review regarding high and low water alarms, and being of the same opinion as he in regard to their use, I can't help but see that the law providing for their use is one of the biggest fool laws ever enacted by any legislature. The law was probably intended all right, but intention don't bring results. In the first place they tend to make a certain class of engineers careless and negligent. Of course this is no fault of the device, but some men rely on them just the same. I know a case in plain sight of the plant where I am employed where the engineer builds a roaring fire under his boilers, and then goes to some other part of the plant and talks with some employe until the low water alarm sounds, when he will start his pump full blast. If there hadn't been any alarm on his boilers he would have been more careful and not depended on the whistle to tell him where the water level was, and it would have been better for all concerned. There are hundreds of plants run in this reckless way and the low water alarms help it along. I am running my plant 11 hours a day and try to keep a constant water level and don't need a low water alarm to tell me when to start or stop the pump. Although there is one on my boiler it has no more business there than a cow in a barn has for a bell. F. E. Warfield.

More About High and Low Water Alarms.

Editor of the Engineers' Review:

In a recent issue I notice an article stating that Prof. M. E. Cooley, of Ann Arbor, Mich., condemns the use of safety water columns and that he is going to ask the next legislature to repeal the law that compels their use.

I am very much surprised that Prof. Cooley has allowed himself to be quoted as sanctioning such repeal. As far as the law is concerned it has little or no value as, outside of a slight stimulation to trade when it was first passed, it has not influenced their use to any appreciable extent. I am in a position to state that the sale of these devices in states where their use is not compulsory is as great, or even greater than in Michigan or Ohio, in fact something like 20,000 safety water columns of one prominent make alone were sold, to say nothing of the hundreds of other makes, before any state had passed laws compelling their use. In this day and age any device that there is any advantage in using will be used, law or no law.

I also note what your article says about the use of safety water columns having a tendency to increase the duties of engineers and firemen. In some of the small plants I admit this is true, but it is in these small plants that the employe's attention is not all required to keep the engine in order. In such places I do not think it is unreasonable to expect the employe to put his time in doing something besides holding down an old chair. In places where inexperienced men are in charge of steam plants the safety water column is as reliable, as much to be trusted and will be found as much of a safeguard as the safety valve, the steam gage or water glass. If you do not think so just step into some small plant and blow the low water alarm and you will find more people on the alert, more heads poked into the engine room than the blowing off of the safety valve ever caused.

If, as your article states, improved devices tend to make employes more careless, you will have to admit that governors should not be used and all engines should be handled with the throttle. Engineers have been known to trust these governors and said governors have proven false to the sorrow of all concerned. Safety valves should be discarded because they have been known to get stuck in their seats and refuse to open. Their obstinacy is so great that boilers have been known to explode and the valves, boilers and men have been blown over into the next county.

Again; why will engineers persist in using sight-feed oilers when the oil is liable to chill or a little dirt get in and stop the feed, causing a melted crankpin box or a ruined cylinder? Far better that the oil be used with a pail. And how about pumps and injectors that engineers start working and that get that "tired feeling" and stop when least expected or desired?

So I might mention many other safety devices and improvements such as automatic stops on elevators (the boy will always stop when he gets to the top and when he comes down the ground will stop him); the guard around the open belt that some careless or drunken fellow will persist in falling over or crawling under; the steam gage that is absolutely correct even if it is "light" 37 pounds; the water gage with the lower connection stopped up and the top valve shut; the water relief valve on the cylinder that is set at 100 pounds and relieves at 650 pounds, or the circuit-breaker that should go out when the lineman backs his connecters into a live wire behind him, but which burns him to a crisp.

All these devices tend to make men more careless and are in the same class with the poor low water alarm with the collapsed or water-logged floats. They should be discarded at once and laws passed prohibiting their use, according to Prof. Cooley's argument.

The truth of the matter is that all such devices are conducive to economy, safety and convenience, and will always be used by those who are up-to-date in modern practice. There is no reason why a safety water column, made without hollow floats that are sure to collapse or water-log, should be any more dangerous to life and limb than any of the other devices, none of which are "fool proof" and all of which must be taken care of.

I do not believe that the Michigan legislature will take such a backward step, neither do I think it will make any material difference in the use of safety water columns, if they do repeal the law at Prof Cooley's request. I trust you will find space to publish this communication in defence of one of the best safety devices on the market today. E. Clement Jarvis.

[For those persons who have not read the editorial in question it might appear that the Editors had attacked the low water alarm. Such is not the case. We merely quoted part of Prof. Cooley's paper. The editorial was really a defense of the high and low water alarm.—*Editors.*]

Fireman Helpers.

Editor of the Engineers' Review:

Fig. 1 is a diagram of a device to save steps for that much abused individual, the fireman.

In a plant using gas for fuel the supply is generally controlled by a regulator outside the boiler house, thus making it necessary for the fireman to make a trip to the regulator at intervals.

The brackets *A* and *B*, Fig. 1, are made from hard wood 2 x 2 x 9 inches, braced with a piece of strap iron. To make this "step saver," commence by making the brackets *A* and *B* and fasten *B* to the side of the regulator house above the lever *D*. *A* is placed at a convenient place inside the boiler room, using ⅝-inch bolts and leaving it loose enough to work easily. Then put more weights on the lever than are necessary to give enough fuel. Then connect a No. 10 wire from the lever at *D* to *E*. The weights are hung at *F* inside the boiler room in a convenient place for the fireman. After connecting the brackets with wire from *H* to *I*, the lever *C* can be raised or lowered by adding to or removing from the weights at *F*.

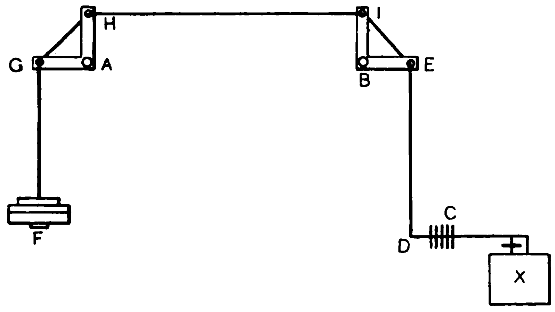


FIG. 1. CONNECTIONS BETWEEN WEIGHTS AND REGULATOR.

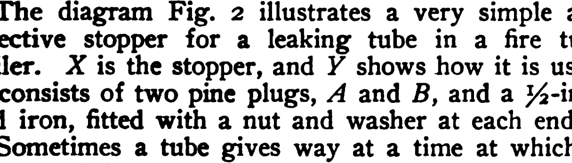


FIG. 2. TUBE STOPPER.

The diagram Fig. 2 illustrates a very simple and effective stopper for a leaking tube in a fire tube boiler. *X* is the stopper, and *Y* shows how it is used. It consists of two pine plugs, *A* and *B*, and a ½-inch rod iron, fitted with a nut and washer at each end.

Sometimes a tube gives way at a time at which it is impossible to have it repaired at once, and I find this an easy and effective way to repair it temporarily.

Steam Engineer.

Water Hammer in Steam Pipes.

Editor of the Engineers' Review:

The editorial "Water Hammer in Steam Pipes," in a previous number of the Review, was well taken, timely and interesting.

The water ram in steam pipes has been a source of trouble to the engineer for a great many years, and I do not think that it is really understood at the present day as it should be. Water hammer is liable to occur in any pipe or vessel containing a liquid. It may occur in a long line of pipe conveying cold water under a high pressure and great velocity, the impact depending entirely on the velocity of the liquid. Supposing there is a long line of water pipe having a plug-cock for a shutoff, open this cock and allow the water to run out under full force; then shut the cock suddenly and note the result. The same may occur when injecting cold water into a steam vessel containing steam under a very high pressure, or turning steam under a high pressure into a cold boiler partially filled with water. If the boiler stayed on its foundation in a case like this it would be something remarkable. Then allowing steam to enter a radiator with a quantity of water in it has a bad effect also.

There is no doubt in my mind that a large number of accidents can be attributed to the water hammer in steam pipes; probably a great many more than the engineers are willing to admit.

When we contemplate the enormous force that may be generated by a quantity of water propelled at a high speed inside of a steam pipe, and then to suddenly stop its momentum, we can imagine what is liable to happen. It does not require a very high pressure of steam to produce disastrous results, five or ten pounds being sufficient to generate a water ram in steam pipes, and providing we have the right quantity of water there will be no question about a rupture.

Let us see what the impact of 50 pounds of water under a steam pressure of 5 pounds would be. Steam under a pressure of 5 pounds blowing into the atmosphere will have a velocity of about 950 feet per second, and the impact would be 50×950=47,500 pounds as the striking force, a force that a very few steam mains would be able to withstand. Suppose we figure the pressure at 100 pounds, and place the volume of water at 25 pounds, the result will be similar. The velocity of steam at 100 pounds open to the atmosphere is equal to about 1,900 feet per second. Then the impact or striking force will be 25×1900=47,500 pounds. We know that water is almost imcompressible, and when it is propelled at a great velocity through a tube or a steam pipe, the force generated is sometimes enormous, depending on the weight of water and its velocity.

I do not think that the above force is always generated in a steam pipe. There may be other conditions that might reduce or increase this pressure considerably. However, it is a fair approximation of what does take place in a steam pipe by water hammer.

Let us take another case: suppose we have a long line of steam pipe with several right-angle bends at the end of the run. This line of pipe is not in use during the night, being shutoff at the boilers, but the valve leaks and the drip used for the purpose of draining the pipe does not work, and allows an accumulation of water to collect, say 25 or 50 pounds. When the engineer opens the valve in the morning (not being aware of the water in the pipe), and especially if the valve is turned on suddenly, under a steam pressure of 80 or 100 pounds, the possibility of an accident from water hammer is very great. Something similar to the above occurred in one of our large

blocks a few years ago. The damage was slight, but it took several days to repair it.

A great many cases of water hammer came under my notice when in the heating business. I have noticed it more particularly in low pressure gravity return heating systems, and caused by the returns becoming plugged, or the return valves closed by mistake, allowing the water of condensation to rise up in the mains; or by leaky water valves used to regulate the water supply to the boiler, causing the heating system to fill with water from that source. Those who have had experience along the above lines will readily appreciate the force of water hammer, especially when the mains begin falling down, and it is a case of lively sprinting for the nearest exit from the building, or be cooked with steam.

Referring to the case mentioned in the editorial. The blowoff pipe was 3½-inches in diameter. I presume it dropped down from the boiler and then turned out through the brick work, using a right-angle elbow. The length of pipe from the bottom of the boiler to the stop-cock would probably be about 8 feet. One foot in length of 3½-inch pipe will hold about 6.33 pounds of water and 8 feet will equal about 50½ pounds. Allowing a steam pressure of 100 pounds on the boiler, there was 50 pounds of water driven at a very high velocity, or about 1,900 feet per second, brought to a sudden stop by the quick closing of a stop-cock. Let me say right here that I never had any use for a stop-cock, especially on a blowoff pipe, of any size, but with one 3 or 4 inches in diameter it is worse.

Just imagine for a moment, an engineer or a fireman gripping a 24-inch wrench, and with one yank closing a 3½-inch stop-cock under a pressure of 100 pounds of steam. It would require something pretty strong to stand that jar. The impact would amount to this: Velocity of the steam 1,900 feet per second, the weight of water 50 pounds. The energy generated equals 50 × 1,900=95,000 pounds. Think of this stored up energy coming to a sudden stop. Can we expect anything else but a rupture? If the engineers felt inclined, there could be quite a number of nice stories written about "what I know concerning the blowoff pipe of a boiler." It would make very interesting reading.

Geo. G. Bennett.

Unions in Connections.

Editor of the Engineers' Review:

I saw in a recent number Mr. Ralph Bingham's connections for a water column. I am wondering how he connected his water column up without any unions. I think he would need three unions, although it can be piped with two unions.

I approve of valves on a water column. We once were troubled by the breaking of gage glasses on our water column and found the trouble to be in the connection of the valve to the gage glass. It was ½-inch out of line with the other valve.

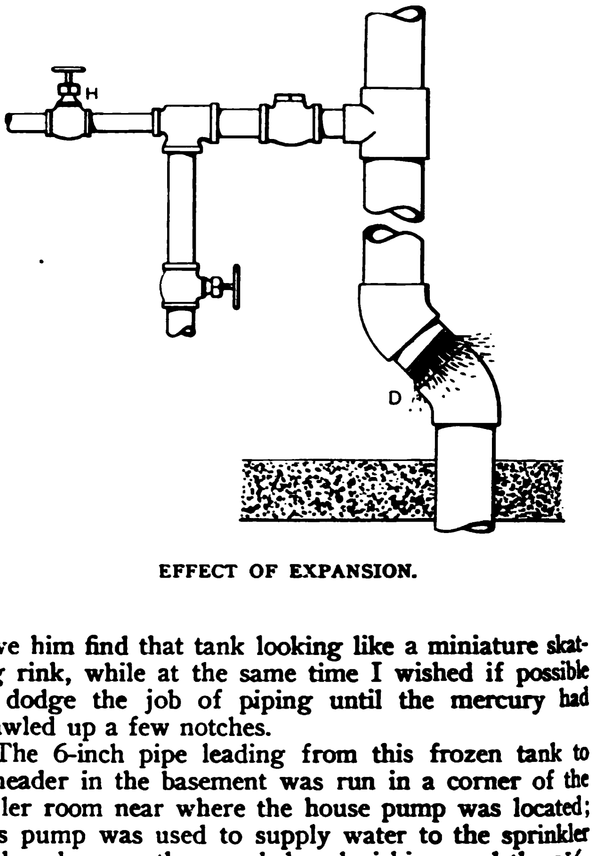
We use lye in our boiler and it is the best thing we can secure for removing scale. Every time we clean our boiler we drop a can of lye into it. Some people have an idea it will cause foaming and will not use it. It does not cause foaming, although we use an open heater and have some oil in our boiler, but the lye destroys the most of it.

Geo. R. Dorr.

Pipe Expansion.

Editor of the Engineers' Review:

A writer in a former issue of the Engineers' Review says that the "power of an expanding pipe is wonderful." I agree with him. I had a little experience in that line a few years ago that I am not likely soon to forget. I was not ignorant at the time, either, of the wonderful power of expanding metal, but nevertheless I entirely overlooked the little matter of making provision for such expansion on this occasion. The water in one of the 12,000 gallon gravity sprinkler tanks on the roof of our building became frozen over to a depth of several inches, owing to the clogging up of the steam pipe leading to the coil in the tank. The weather was intensely cold, and as the steam pipe leading to this coil had filled with water, froze and split, it meant some work of a very disagreeable kind to get a new pipe into the tank.. However it is just at such times the fire insurance inspector is most likely to pay a visit, and I wasn't anxious to have him find that tank looking like a miniature skating rink, while at the same time I wished if possible to dodge the job of piping until the mercury had crawled up a few notches.



EFFECT OF EXPANSION.

The 6-inch pipe leading from this frozen tank to a header in the basement was run in a corner of the boiler room near where the house pump was located; this pump was used to supply water to the sprinkler tanks whenever they needed replenishing, and the 1½-inch supply pipe to the tank was connected into a tee, as shown in the illustration. The brilliant idea occurred to me to connect a steam pipe in the manner shown at *H*.

I reasoned that a steam jet connected in this way would rapidly heat the water in the pipe. The heated water would then, if I knew anything of the laws governing such matters, chase itself up the pipe and into the tank, where being still governed by the same laws that caused it to travel up the pipe, it would immediately mount to the top of the tank, and the ice and my troubles would simultaneously disappear.

The scheme worked beautifully for about ten min-

and had the tank and piping been constructed
the pattern of "The Wonderful One Hoss
," there is no telling what wonderful results I
t have obtained.

it was the illustration shows the result of a ten-
te operation of the scheme as at *D*. Owing to the
nsion caused by the strenuous action of the steam
ıe 6-inch pipe tore away at the 45 degree elbow,
he full stream of water, under a head of 125 feet,
ed into the boiler room, while at the same time
ıe alarm bells connected with the sprinkling sys-
set in motion by the shock and jar to the piping,
ringing wildly through the building, adding not
le to my enjoyment of the situation. By the time
n had reached the roof and shut off the valve at
ank, most of the water it had contained was
ıing around the boiler room and contiguous
ory. I found that the pipe had only been en-
two and a half threads in the elbow where it tore
; it had afterwards been calked, which still fur-
weakened the joint, but I blessed the careless fit-
ho did the work, for had it been as strong as the
of the joints the result might have been far more
us.

e Foolkiller was, doubtless, too full of business
time to attend to my case, else I should not now
a position to relate this story of a brilliant scheme
miscarried. Dennis.

Setting Up a Bag.

r of the Engineers' Review:

ee Mr. Thomas Henan wants information in re-
to setting up a bag in a boiler, and he can't un-
and why a hole should be drilled in the bag. If
ag is only a small affair, say as large as your
or a little larger, it is not necessary to drill a
but where the bag is large a hole is drilled in
to take up the slack, as it is called. When they
set up the bag they let all of the water out of
oilers and either use a forge or a piece of sheet
containing charcoal, and heat the bag to a white
then a man goes inside of the boiler and holds
dge hammer to the plate while the men on the
de knock the bag up with hammers. When the
s large a hole is drilled in it and after the bag
up the hole or holes are riveted. I have seen as
as three holes put in a bag.

ee where J. M. L. gives particular attention to
ing out an injector. I have fixed many a one
illing them out after I learn the size of the hole
injector tubes. I drill out the delivery tubes by
g a drill just large enough to run in the tube
ound it up. If I use a ⅜-inch drill in the de-
tube I take a drill that is 3-16 inch larger for
eam tube, and true it up in the same way. Then
e got a set of jets equal to new. The steam tube
always be the largest, just as the steam end of
np is the largest.

w he cannot understand why his faulty injector
ed up his boiler quicker than the good one. That
ad easy to me. His tubes had worn and they
larger quantity of water pass through them than
ood injector did. When a man tells me he never
ny trouble with injectors, it is because he never
ed many or he is —— A Crank.

Lye in Boilers.

Editor of the Engineers' Review:

In connection with the above heading I wish to say that lye can not be used where there is soft water or where the water drains through soapstone quarries or through a lot of shale.

Such waters are very soft and lye will cause serious trouble if used with them. When the water is so soft, the potash and other ingredients in the lye cause something very similar to soapsuds. Lye is used only where the water is hard, and the harder the water the better the lye will work and the more of it can be used. When using it commence with a small amount and note the way it acts and increase the amount accordingly.

I once ran a dynamo that gave me trouble from the time it was new. It would get so hot that the oil would smoke after it was drawn from the oil reservoir into the bearing. I tried all kinds of oils without any relief and finally I used graphite in the form of a fine powder in the ring oilers of the dynamo and to this day I have not had the least sign of a hot bearing on the machine.

The only difficulty I had was that the graphite would settle in the bottom of the box when the machine was shut down and would not move when it was started. To overcome this, I put a short piece of ¼-inch hose on the pet cock used for draining the oil. After starting I would open the pet cock and blow in the hose. That would stir the graphite from the the bottom where it had settled and everything worked all right.

Joseph K. Mercer.

Little Things that Bother.

Editor of the Engineers' Review:

The boilers we have are fitted with hand holes in the rear heads beneath the tubes which, although a great convenience, when cleaning the boilers, gave us much trouble on account of the nuts burning fast to the bolts. Figs. 1 and 2 show how we overcame the trouble by screwing the bolts into the bush in the plate where the threaded portion does not get hotter than the water in the boiler. This cured this trouble entirely.

We are also troubled with the screwed ends of the through braces leaking. After trying for some time unsuccessfully to stop the leakage, we hit upon the expedient of using a concaved washer on the outside, placing between it and the boiler head a wire insertion asbestos gasket 1-32-inch thick and the full size of the washer. Between this gasket and the washer we placed three or four sheet rubber rings of a size that will squeeze into the countersunk portion of the washer. It proved an entire success. Fig. 3 is a sketch of the arrangement which may make the matter more clear.

These boilers discharge their steam into a drum 14 inches in diameter by 30 feet long. All of the steam outlets are either on top or so far above the bottom as to make especial provision for draining the drum necessary. This we did by tapping the bottom of the drum and the top of the boilers for ½-inch drain pipes, placing on them a globe and a swing check-valve, which permits the condensation to return to the live boilers. In addition to this, we have a 1-inch drain to the sewer which is opened when all the boilers are cut out.

One trouble with swing check valves is that after they have been ground a time or two, a shoulder is raised on the face, which occasionally comes on the seat, causing leakage. We had some of the disks faced off in the lathe, but this being too much trouble, we found a brass spool that was true on the end and had a hole put through it. By cutting a hole through a piece of emery cloth and laying it on the brass and turning the disk with a brace and screw-driver, we get a nice true surface which with very little grinding makes a tight job.

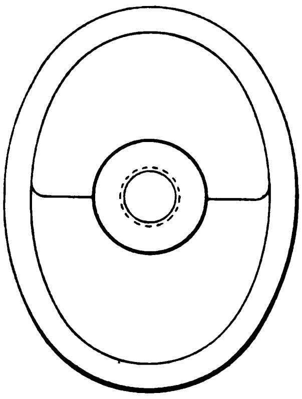


FIG. 1. HANDHOLE PLATE TAPPED FOR STUD.

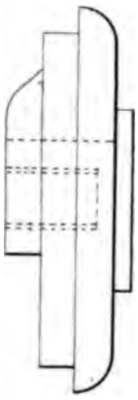


FIG. 2. SIDE VIEW.

I would like to have someone tell us how to repair gate valves successfully without spending a lot of money on tools.

While writing I want to confess that I was never able to grind a plug cock so that it leaked less than when I commenced. Prof. Sweet says that a thing that does not tend to wear out of true wears very little.

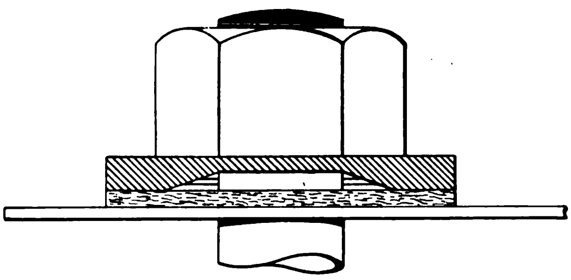


FIG. 3. WASHER AND GASKET.

All the plug cocks I ever had anything to do with had a tendency to wear out of true, and placing an abrasive between the wearing surfaces and turning the plug seemed to increase that tendency a thousand fold. If I were up against the proposition, I would want to machine the parts so true that the grinding would only be make-believe. Lots of fellows have told me they could grind a cock so that it would be absolutely tight, but they did not show me.

While finding fault with the things that be, I want to protest against the custom of the makers of pipe plugs, of placing a little wart on the end of the plug, and expecting us to be able to turn it out of a fitting after it has had time to set. Usually, where possible, I screw the plug into a coupling and nipple, which gives me something to get hold of with a pipe wrench. The head of the plug should be about the same distance across corners as the diameter of the plug.

Some of these times when we are having some pipe flanges fitted up we are going to have a raised ring about ¼-inch, or less, in width turned on the face, and try to do away with the gasket, as Prof. Sweet does in his engines. Saw Mill.

Quick Boiler Repair.

Editor of the Engineers' Review:

The saying that "Blessed is he who knows his own limitations" is merely a different version of "Fools rush where angels dare not tread." An incident that occurred some time ago brings these sayings to mind.

I went out to a small town to indicate a Corliss engine. When I got there I found everything was cold because one of the 6-inch flues in a return tubular boiler had sprung a leak somewhere near the middle. The man in charge, (I won't say engineer,) got a pine block and fitted it to the flue, driving it in with a piece of 3-inch pipe, but he drove it beyond the hole. He then put another piece into the flue, but did not reach the hole.

While driving the last piece in, the block being soft, the pipe would sink into the block and stick. He looked around and found an old governor ball that would just roll snug into the flue, so in it went and he had something solid to drive against.

The plug driven home, fire was put in the boiler and steam raised. The engine started up again and all were happy. They had run about an hour when with a roar the boiler turned loose. The steam had leaked in between the plugs till the boiler pressure was reached, 110 pounds, and as the front plug was the looser, the flue converted itself into a cannon. The ball and plug went out through the heavy doors and some distance out into the yard.

The fireman had just fired the boiler and had gone out after more coal. There was a tramp in the boiler room who was scalded slightly. My advice was asked and a suggestion was made that I put in another flue, as they had one on hand. I most respectfully declined and advised them to get a boiler maker. They decided that they would send out in the country and get a man who ran a small saw mill. He came and after looking at the boiler said he could have it going in an hour or so. I played the interested onlooker and asked him what he would do about riveting the flue in the rear head as the flanges were turned in. He said that wouldn't make any difference as the rivets are not necessary. He cut out the flue, fitted in the new one, expanded it in the head with the ball peen of a hammer and had fire in the boiler in less than two hours. The most wonderful part of it all was the boiler did not leak and held the pressure all right, and at this time has been running for two seasons and has not troubled them in the least.

I left there with a decidedly lowered reputation as a mechanic and if I were to apply for a job in that town, I probably could not get one rolling a wheelbarrow.

This fact impressed me: the workings of steam and ı apparatus are wonderful and unaccountable, ıere was a boiler, that according to my teachings experience was dangerous, running along and g good results, where I have known of others, ınd kept up in the best of manner, that have ex- :d, killed and destroyed.

ıis all brought to mind a favorite saying of an old ıeer, for whom I worked when I was a boy, "that is a special providence for fools, drunkards, :rs and children." I am convinced that there ıne truth in the saying. W. C. VanHoose.

Valves Groaned.

ır of the Engineers' Review:

is particular engine was started up early on Mon- norning, after being idle from the previous Satur- by the engineer who was to run nights last week. :arting up on Monday morning, the exhaust valves d almost always groan and squeak.

e work this engine had to do was very intermit- After doing its best work for a short interval, tantly had no load upon it for a moment. At this the governor would release the steam valves alto- :r and they would stand still for that time. The :quence of this was that there would be a partial ım behind the piston which would drag back on it ıinder rather than assist the steam in pushing it ırd. This caused the exhaust valves to rise from seats sufficiently to make a disagreeable knock- To balance this atmospheric back pressure on the n, and, incidentally to stop the slamming of the s, the superintendent of the mill had ½-inch : valves put on each end of the cylinder. These :d in and were attached to nipples which were ved into the holes made for the indicator piping.

will now be understood how the cylinder was with cold air when the steam valves were not ing. Now we have an opportunity of making an ıgement for supplying graphite to the cylinder and s. We attach short nipples to the out end of check valves and on the nipples we screw elbows, ng them open end up. In these we also screw es and then 1½ by ½-inch reducers. The large end formed a convenient funnel-shaped opening ıgh which we could apply graphite or oil to the der and exhaust valves when the engine was doing ork, as occurred at short intervals, when the piston d draw air into the cylinder through the check s.

before stated the exhaust valves would begin to ık and continue to do so all day unless an extra :ity of oil or graphite or both was supplied to in this way. The regular supply of oil from the :ator was not sufficient to prevent the squeaking.

starting up Monday morning I supplied a little oil to these valves, which would stop the squeak time. Then I tried oil and graphite together, ı stopped the squeak for the week.

ere are many other uses for graphite around the ı plant, as most engineers are aware, but success use may, like everything else in engineering, even to the painting of an engine, "demands perse- ce, attention to details and thoroughness."

W. I. Day.

The Engineer Again.

Editor of the Engineers' Review:

In one of your former numbers, W. A. B. takes a fall out of O. E. on engineers. He says "I saw a hoisting engineer manipulate his levers, and I would not hesitate to class him as an engineer." I have known men who were experts in the handling of levers and hoisting engines, but were they engineers? Hardly. In the mining country they are commonly called brakemen. Some of them are no doubt engineers, but the majority of them are men who never did a day's firing in their lives. Can a man be a successful engineer if he has never been a fireman? I think not. What is an engineer? To my mind, one who can take charge of a plant, keep it in repair, one who understands boilers perfectly, or who in fact can run the whole plant successfully. To me the hoisting engineer is a class by himself. As W. A. B. says, if the man who runs the 10,000-horsepower plant took hold of those levers he would fall down no doubt, but I will gamble that the man who runs the 10,000-horsepower plant would have an easier time and catch on sooner than the man who manipulated the levers would if he tackled the 10,000-horsepower plant.

S. E.

Handy Devices.

Editor of the Engineers' Review:

In the plant where I was at one time employed we had six large Sturtevant coil heaters, with large fans blowing hot air through large galvanized pipe to heat the factory. Those coils were heated with exhaust steam carried from 400, 600 and 800 feet in a large pipe from the engine room to the heating coils. The returns were taken back to a pit in the boiler room by gravity. A 4-inch pipe was connected to the condenser at the top. The cold water entered the coil at the top and came out through a 4-inch outlet leading to the vacuum pump. The returns emptied into the condenser at the top and were of course condensed there and nothing but water went to the pump suction. When I went there it was piped up with a lot of valves and traps, that did not work, so I took them all out and run it with only a trap in the live steam line to the engines. The returns had all of 10-feet fall, so I piped them up again, giving them about 3 to 4 inches fall, to each 100 feet up to the condenser. The 1-inch cold water pipe to the condenser coil made up the deficiency and by watching and regulating the water with the valves

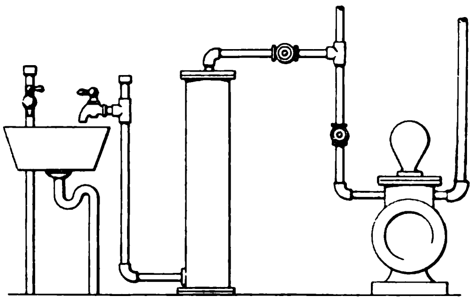


FIG. 1. TANK FOR CONDENSED WATER.

I could keep the water in the heater up to a certain mark very easy.

We had a 1,250-horsepower Webster heater and our water was from 210 to 212 degrees of heat. We had our heater raised 4 feet so it would feed to the boiler feed pump by gravity, thus causing no trouble in pumping.

We had bad water, full of salt and 100 grains of impurities to the gallon, and we had to put in a water purifying apparatus and I never had so much trouble in all my life with water before. The 2½-inch boiler supply pipe closed up so that only a ½-inch hole was left in it. After I got the water settled and filtered it was about 96 per cent pure, but I could not remove the salt.

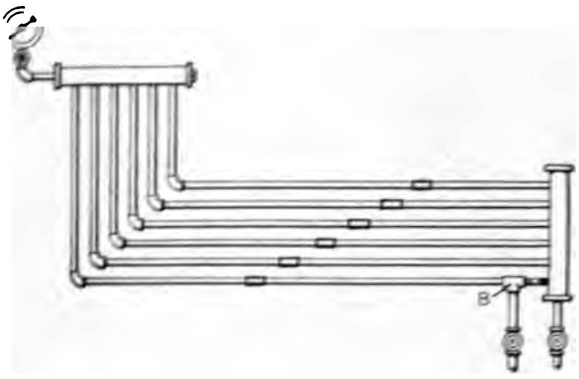


FIG. 2. RETURN FOR HEATING COILS.

Following are a few kinks I have used. Fig. 1 is a tank to catch condensed water to wash with. I will show it just as I had it connected. I put a tee in a pump live steam pipe and connected a pipe from it to the top of an 8-inch capped pipe 4 feet high. This is kept full of condensed hot water all the time for washing hands, face, etc., by connecting a pipe at the bottom as shown and running it to the sink. This arrangement will be found quite useful.

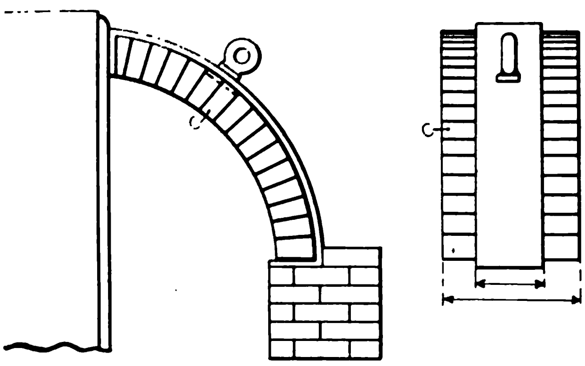


FIG. 3. BOILER BUNGS.

In my heating coils in order to save one run of piping I connected up the coils as shown in Fig. 2 in which pipe *B* is the live or inlet pipe. This pipe was cut as shown at the tee and the tee screwed in place. Then a right and left hand plug was screwed into the tee and manifold as shown. I have a good many coi working in this manner and they are easily managt and are good heaters. I beat with exhaust steam wi from 3 to 5 pounds pressure. The plug is solid iro

Fig. 3 shows a boiler "bung" for the rear of tl boiler over the combustion chamber. This does awa with all the trouble of bricklaying; it is simple an does not cost much. This "bung" is made of 4½-inc iron and bent so the circle will fit the boiler and rea brick work when resting on an angle iron. A sectio can be lifted out and set back without disturbing othe sections. A clay wash can be used to cover the crack if you wish to make them absolutely tight. The fir brick *C* is set in tight and will last for 10 years.

J. E. Boegen.

A Pump Room Contest.

Editor of the Engineers' Review:

It is no use talking, this staying out nights an taking in late suppers is enough to undermine the constitution of any one. Last Wednesday night the engineers had another blowout, and, of course, I went wit them. We had all kinds of salads as usual and severa kinds of fixings, and I didn't know what they wer and don't yet, but we had a good time and voted to hol another one in another month. When I got home turned in good and tired and it didn't seem a minut before I was sound asleep.

Everyone has heard more or less about telepath and a good many are firm believers in it. I mysel am undecided as to just what significance to place upo this mysterious influence, but sometimes I am incline to think there is more in it than a great many peopl imagine.

It didn't seem as if I had been asleep more than minute when something woke me with a start, and again had that feeling of irresistible attractio which seemed to compel me to get up and dress an go down to my steam plant. I tried to fight it of knowing the outcome of the other experience whic was the result of an overloaded stomach, but the mor I resisted this mysterious power the greater was th incentive to do contrary to what common sense told m was folly. Finally I could stand it no longer and s started out on my two mile walk with the thermomete down to six below zero.

The journey to the plant was long, cold and tediou and several times I felt that drowsy feeling which w are told takes possession of a man when he is nearl overcome with cold, but each time this was fought of and the journey resumed. Only once did I find m progress interrupted, which was by a policeman, wh stopped me and wanted to know where I was goin and what I was doing out at that time of night i that kind of weather. Upon telling him my errand h seemed undecided whether to arrest me as a lunati or to allow me to proceed on my foolish errand.

I finally arrived at the plant and upon entering wa greeted with the warmth which almost made me gla that I had come. It seemed as if I had never see the old engine room so nice and comfortable befor As I closed the door, I listened for any indications o things out of the ordinary, but all was quiet as th grave and about as dark. The clock ticking upon th wall, the faint hiss of escaping steam from some stea valve stem, and the occasional squeak of a mouse, we nly sounds that greeted my listening ear. The ıe and the Corliss stood in their accustomed places ene as ever, the fires in the furnaces of the boilers quietly and peacefully smoldering away, and I ı to think that after all I would have shown more if I had staid at home in bed.

t caring to leave the plant without giving it a ugh investigation, I went into the pump room, : my pumps which were used for various purposes located. We had two duplex steam pumps, ;implex and one power pump, which was belted countershaft and used for boiler feed. Here thing seemed to be in harmony with the surlings and the silence was only broken by the ocıal splash of a drop of water as it fell into a drip ınder the pump.

ıad turned away undecided whether it were · to go home and finish out my night's sleep in ıfortable bed, or rather than brave the cold, long to spend the night in the plant on a shake down : engine room floor. I had just put my hand to .tch of the door when I heard a voice say, "Oh, ellows are so constituted that the least little thing ı to give you indigestion in your steam chest. grunt and groan if they give you a little too much ıd throw off a dark colored substance that would ıny one the impression that you had consumption. u don't get enough you make just as bad a noise ou kick up if you don't get a steady diet or what :all cylinder oil. Now, I don't need any such ering as that; all they have to do is give me e water I want, shove the belt over and I will e rest.

'ow just give me a chance to have my say," con- l the voice as a slight clank was heard from ıther side of the pump room, "I know just you are going to say and it has all been said :. You know you have to have a lot of kerosene ›sed into you three or four times every year to your chest clean, and you know you don't work troke half the time, and if you don't have cushın your chest you make a noise that would make hink a good hard solid foundation wasn't good ;h for you."

ay, who are you talking to," inquired a pump the opposite direction; "are you referring to old x, or to me? Because if you have me in mind, 'ant to cut out just about two-thirds of what you said and start off on another feed line. You see me short stroking, and I don't need kerosene loosen up the digestive organs in my chest, bethey are positive in action, and the way they me nowadays I am just as good as the next fel- I can hold my own with any power pump that :ver made. Just put that behind your plunger orce it."

on this another voice spoke up and said, "Anyvould think to hear you two talking that there only two pumps made, one was a power pump he other a simplex. You two water pushers want to lose sight of the fact that there are ;, and by others I mean myself, and I don't mind ŗ that I am IT. Old simplex over there talks his being positive in action, and when he says e just as much as says that I am not. Isn't that h to make your air chamber get full? Why, if there was ever a pump that had positive action, it's the duplex, which was never known to go back on an engineer so long as it was used with any degree of decency. Now, there's no use of talking about our merits, one over the other, because talk is cheap, but it takes money to run a pump. Now I have got a proposition to put out to you two, and it is that we try and see which pump will operate the longest with the least expense, and if that doesn't show which one is the best, I will have no more to say."

There was a silence for a moment, then the power pump accepted the proposition, but with a rather doubtful tone of voice, I thought, and I felt a little ashamed of it, knowing what good work it had done for me. It wasn't long before the two simplex pumps agreed also and the test was on. It was agreed that such items as cost of power for running the pump, oil, packing and repairs and every other item that could possibly figure in should be counted in the test. As the discussion seemed to be over and as there seemed to be no call for me staying around the plant any longer, I returned home and crawled into bed.

For the next six months or a year no engineer ever had an easier time with his pumps than I did. The oil cups were filled up the next morning and ran for weeks and weeks before they required filling again, which showed that the power pump was trying to be as economical with oil as possible. The lubricators on the steam pumps were also filled, but it was months before they were empty, and it was a toss up as to which lasted longest, that on the duplex or the simplex pump. The packing in all the pumps, which had already been in five or six months, seemed to get better than ever, and, in fact, it seemed that a pump could not work more economically and satisfactorily than my five pumps were working. Thus it went on week after week and month after month. The supply man became discouraged and ceased to call, because it was only a waste of time, as no supplies for the pumps were required in any way, shape or manner. One of the repair hands in the machine shop lost his position because there was nothing for him to do, and the superintendent came out and raised my pay, he so appreciated the fact that the repair bills and that of operation had been reduced to such a satisfactory figure. I was just making up my mind what I would do with the advance in salary, when I was startled by a loud call which said, "John, breakfast is ready!" and, would you believe it, that economical operation of my pumps was nothing but another dream, and it was time to get up and once more wrestle with steam and power pumps, and other steam plant troubles.

Indigestion.

Pumps — Painting Stacks.

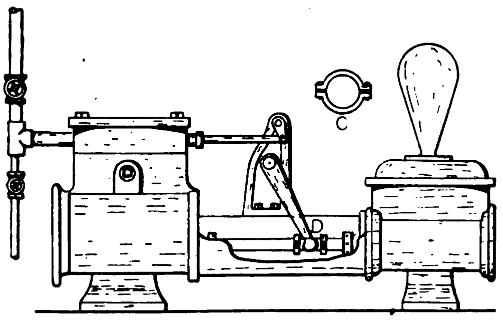
Editor of the Engineers' Review:

The letter by L. A. Cole brings to mind a scheme that was worked on a pump in almost the same way as he did on the pump illustrated on page 32 of the February number. The difference is that instead of making a nipple and taking the pump apart to get it on the rod, we made a couple of collars like the one shown at *C* and secured them to the rod without disturbing the rod in the least, as shown at *D*. His idea for a lubricator seems to be all right, and it looks as if it would work.

I am with W. C. Bosworth in his way of thinking about stokers, firing by hand, and smoke preventers or consumers, as they are called. If a furnace is not managed rightly there is no kind of a stoker that will operate without making a smoke, but with mismanagement in hand firing the smoke will be far worse.

The way to get the blocks up to the top of a stack ready for painting, as shown on page 35, seems to be a good one, but I would like to know how Mr. Decatur would proceed to paint the stack in case there was no small rope through the pulley for that purpose? It is evident that he don't think the editor's way is what is wanted and seems to have his doubts about the average man being able to do the trick as the editor directed.

I will say that it can be done, because I have seen it done in almost the precise way as was given in the answer to the question by Mr. W. G., in the November issue. We had two iron stacks, one for each boiler, and they wanted painting the worst way, but no one in the place knew how to do the job. One day a couple of men came along who made painting stacks a specialty, and as they offered to paint both stacks and the boiler fronts for a certain sum, they got the job. The way they went about the stack painting was practically the same as was stated by the editor, and it didn't take them very long to earn their money.



COLLARS FASTENED TO THE PLUNGER ROD.

I know of another instance where the stack painter did not have the friendly rope and pulley to help him get the tackle up to the top of the stack, neither could he climb up on a ladder and push a pole up to the top, but he painted the stack just the same, and it was a case of hanging on by his eyebrows to do it. He shinned up the guy rope, which came to about 15 or 20 feet from the top of the stack, and attached his small block and tackle to the ring in the band to which were attached the guy wires. Then his partner attached the heavy blocks and rope and it was lifted up in that way and the block attached to the ring by the man who was supporting himself on the guy wire. After the blocks were in position the rest was easy, as another shorter block and tackle was hoisted up and placed in position by means of a pole having a small pulley in the end, as has already been described. If I hadn't known of this case I should have said that the thing was an impossibility, but the stack was painted from top to bottom and is standing today. I wouldn't advise anyone who cares about living to a good old age trying to do the same thing, as it must take a steady head and a "know-how" as to gripping the guy wire in getting up to the top, without resulting in a broken neck.

R. W. Diefendorf.

Pumps — A Reply to Whiskers.

Editor of the Engineers' Review:

At last the expected happened. Somebody has poked his critic's stick at me. I am very glad indeed that some one of the many readers of this paper has called me down. Brother "Whiskers," on page 18 of the January number, asks for information on the pump in question, which throws a steady stream of water.

Well, Whiskers, old man, nothing would please me any better than to have a personal visit from you when we are again in operation, for I would be glad to show you my 2 x 4 plant, especially the pumps; then have a smoke or two and go fishing.

I have run nine different makes of pumps in the past 18 years, some were good, some bad, and some were good for nothing. One of my weak spots is, everything is good until I see something better. In years gone by the meanest and most contemptible thing I run up against was a bucking pump. I paid particular attention to these water pushers, and carefully noted all their symptoms, etc., and at last I thought I had the perfect pump, but no; I came across another over in New Jersey. When I took charge of the plant it looked as if something was missing, lost, strayed or stolen. Everything was sloppy, slippery and wet. There was not one tight joint about the whole shooting match. In looking over the place the next day I saw a new make of pump, to me, lying out on a scrap pile. The superintendent said it is N. G., as it had only run three weeks and then would not budge, and after losing nearly three days monkeying with it, they threw it out on the scrap pile.

I got interested and wrote to the makers for a catalogue and after receiving it, I took the pump apart, but found nothing wrong except that the packing was missing from the water end and the head on the steam end was not put on according to directions. This pump was fixed up at a cost of 44 cents. I connected it up and started it to work, and after watching it carefully for a couple of days I said to myself, "that's the best one yet." I still think it has no equal.

The pump that throws such a steady stream is of the following size: Steam cylinder 4½ inches; water cylinder, 3 inches, and stroke, 8 inches.

The 2½-inch suction line is now 72 feet long and the pump sets 19 feet above the water level. The 2-inch discharge line is 592 feet between the pump and tank. In this length the outlet is 66 feet higher than the pump. The steam line is about 580 feet long, starting at the boiler with 1-inch pipe and running 212 feet with this size; it is then reduced to ¾-inch and runs to within 16 feet of the pump, where it is once more reduced to the regulation size, ½-inch. The boiler pressure is 100 pounds, but at the pump it is not over 40 pounds. When the pump is running it just steps off 96 strokes a minute with an 8-inch stroke, and the water comes out of the pipe at the tank in a steady stream. When I say steady, I don't mean by jerks or pulsations, but a plain, every-day steady stream. This can be sworn to by every employe about the place.

If I could not get another one like it I would not take $500 cash for it today. The repairs on it since May 2, 1902, have been 27 cents. This pump gets my undivided attention, *i. e.,* it gets just enough oil to run nice and smooth and occasionally it gets a cleaning up. So while it looks as if Mr. Whiskers was right, he is and he is not.

While we all contend that a crosshead comes to a standstill at the end of each stroke, the belt on the pulleys travels just the same, and while the piston stops at the end of each stroke in a pump, the water runs out just the same. Harry C. Faber.

A Few Pump Troubles.

Editor of the Engineers' Review:

As you have about everything pertaining to the engine room, I have taken the liberty to send in a few illustrations to show how I fixed my pump which had been growing from bad to worse and made a noise while running like the clank of a prisoner's chain. There was nothing out about the pump except that the holes in the links, valve-rod jaws, rocker shaft and levers were worn oblong; the pins which went through them were also worn, as shown in Fig. 1.

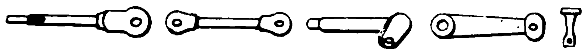


FIG. 1. WORN HOLES IN LINKS, VALVE STEM JAWS AND ROCKER ARMS.

When I made up my mind to repair them, I had intended to ream the holes out and make new pins, but upon examining them I found they were worn so bad that it was advisable to drill out and bush and make pins the same size as the original ones. This is shown in Fig. 2.

A few words about drilling out worn holes may not come amiss, as there is danger of either breaking the arm lever or of getting hurt if the work is done in a drill press and an ordinary drill used. There is danger of breaking the work if the drill catches, which it is sure to do. The best way is to get a reamer and ream the holes out to the desired size and if it is impossible to get a reamer the holes may be drilled, if the operator is careful, by backing off the cutting edge of the drill. If an engineer is so situated that he cannot get bushings made, the worn holes can be repaired by filling up with babbitt and drilling out the size of the pin. Of course the babbitt will not last as long as an iron or steel bushing.

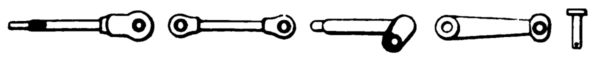


FIG. 2. WORN HOLES BUSHED.

Considerable has been said about pumps and how to pack them and packing in general, and considerable might be said about the stuffingboxes and how the builders might with good results make them deeper and not do any harm. If there is anything that makes an engineer feel tired, it is to have a pump that has a stuffingbox about half as deep as it ought to be.

I fail to understand why they are made with such stingy affairs unless it is that the manufacturers have it in for engineers.

I have got one that will take just about one and one-half rings and a tight fit at that. Of course it is not necessary to state that it is not possible to keep the piston tight, for any engineer knows that. The way I got out of the trouble was by using a packing of my own which is a combination of soft wire solder wound with asbestos wicking which is dipped in a mixture of graphite and cylinder oil. At first the packing leaked, but as it became fitted to the rod the leak gradually stopped, and now it is as tight as any pump. I don't know how this will work on hot water as I have not tried it, but I should think it would be all right, as it forms a kind of metallic packing.

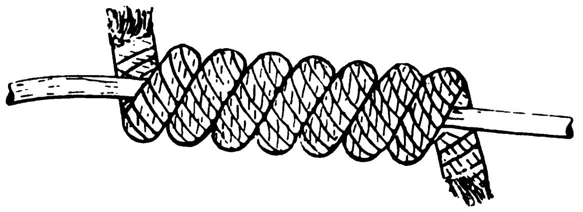


FIG. 3. HOMEMADE METALLIC PACKING.

H. Hiser.

Pumps.

Editor of the Engineers' Review:

I noticed a letter from Harry C. Faber in a recent issue of the Review. I don't think he is right where he says that a duplex pump gives " duplex troubles " as compared with a single pump. I have talked with a great many engineers relative to the merits of the single and duplex pumps, and all seem to agree that while a pump of the duplex construction may use a trifle more steam, it is certainly much more reliable and simple than the single style of pump.

I know of a power plant in Chicago that I see very often, which is equipped with a duplex and a single boiler feed pump. The single pump is of a well-known make, but I think is very unreliable as I have known it to stop running several times as soon as its supply was throttled down a little. Of course the fireman was right there and simply pushed the valve rod over and started it up again, but something might be doing if he happened to be somewhere else when the pump stopped. The duplex pump has never stopped working even when slowed down so that it hardly moved.

I think Sam was right in the Engine-room Chats in the Feb. 1904, number, where he said that a fireman could always depend on getting water into his boiler if he had a duplex pump.

I should like to see some careful tests made at some plant to determine how the two types of pumps really stand.

I now have a question which I would like the readers

of the Review to answer. In a small hotel in a little town in Maine there was an old tubular boiler used for heating purposes. The boiler was pretty well used up, and I believe was originally a power boiler. It now carries 40 pounds of steam, while when it was used for power purposes it carried about 60 sometimes. The fireman sometimes let the pressure get way above 40 pounds, and as the noise of escaping steam was objectionable he hung weights on the safety valve lever. When I asked him if this practice was not dangerous he said, " Of course not, because that biler had run a pump wid 60-pound pressure." Now I say that as the boiler was never cleaned, and was used up anyway, a pressure of 40 pounds was plenty for it. The boiler maker probably knew what he was doing when he said that 40 pounds was all it could carry.

Was the fireman right when he let the pressure get above 40 pounds? Hugh G. Boutell.

Pump Troubles.

Editor of the Engineers' Review:

A good deal has been said about pumps since engineering papers have been published, but from what I can see, there is just as much need of information today as there ever was. It is wonderful how some of the pumps will run and do the work required of them when they are in such a condition as some of them are. It may be truthfully said that the majority of pump troubles come from leaks of one kind or another. The old familiar air leak gives the engineer as much trouble as ever, and although he has been warned against it for years, he will still persist in laying a suction line with old pipe that may or may not be full of holes. The joints are made up of any old thing, and when the job is done, he has the fun of going over the line to find the leak that invariably exists.

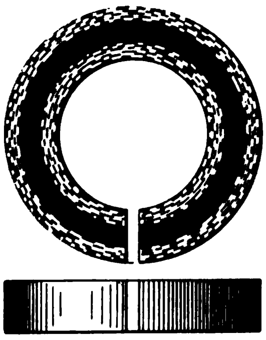


FIG. 1. SQUARE CUT PACKING.

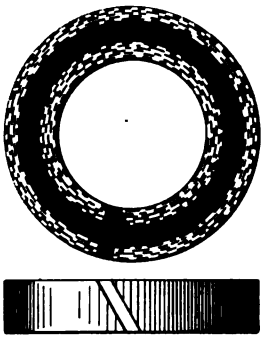


FIG. 2. CUT ON A SLANT.

Another gets good pipe and new couplings and sets to work. He is in a hurry, and so slaps every thing together in a rush, forgetting that it is important to make the joints perfectly tight, or perhaps taking it for granted that they will be so when the pump is started.

A leaky suction pipe means a partial destruction of the vacuum, and the value of the suction pipe is determined by the ability of the pump to remove the pressure from the interior of the pipe so that the atmospheric pressure may not be hampered in forcing more water into the pipe ready for the next stroke of the pump. If there is an air leak in the pipe the lift will be hindered and the water will not be supplied to the pump in sufficient quantities.

It would be a good idea for every suction pipe to have a vacuum gage on it, and then the engineer can tell at a glance what amount of vacuum he has in the pipe. If the gage shows 28 inches or over, the leak need not worry him, neither need he expect much better; but if the vacuum is down to 18 or 20 inches, it is evident that there is a serious leak in the suction pipe, or the valves or piston are leaking. This may occur if the valves leak enough to destroy the vacuum.

A leaky water end will cause a loss of steam. I went into an engine room recently and saw the boiler feed pump running at twice the speed it should if it had been in condition to do the work. As it was, the water was churned back and forth, but at every stroke of the pump the steam cylinder was filled with steam, as the ordinary pump has no cutoff, and the steam was exhausted into the air without having accomplished its work. The pump needed repacking, which would have admitted of its being operated at about one-half the speed and throw a greater stream into the boiler.

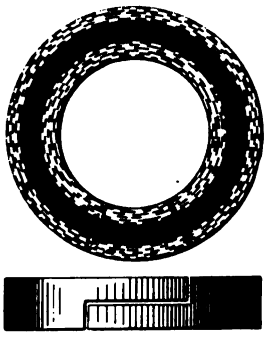


FIG. 3. FLAT OVERLAPPING JOINT.

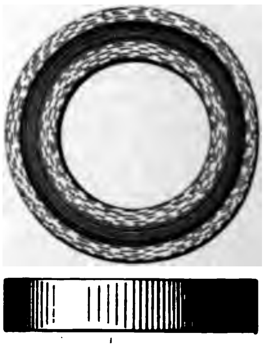


FIG. 4. SOLID RING.

On the other hand a pump can be packed too tight; so tight, in fact, that a steam pressure of 100 pounds to the square inch will not run it. I recall one instance in my experience where I got caught in this respect. I had just got a new supply of packing, and as the pump barrel was rather rough, it was a hard pump to keep tight because the packing wore out so fast.

When I went to pack the pump I concluded I would put in all the packing I could, and I did. When steam was turned on the pump refused to start, and I could not think what the trouble might be, but when I tried to pry the plunger over to one end, I quickly found out why the pump would not operate. The plunger could be scarcely pried from one end to the other. When some of the packing was removed the pump worked all right.

I have found there is a right way to cut the packing for a pump when it is to be used on the water end. The average engineer will cut his packing with square ends as shown in Fig. 1. This is not a good way to do, for although it may be tight at first, it will leak as soon as it wears away a little, although the joints may come differently, for as soon as the rings wear the spring will press the packing out and so open up the joint.

In Fig. 2 a far better joint is shown and will keep reasonably tight. It will, however, open up as the ring nd so allow water to slip past. The ring shown 3 is the best way to make a split ring I know of l allow of all the wear the ring will stand. Fig. olid packing ring and is the best thing I have d on cold water.

e found that trouble with pumps is, as a rule, l to the water end, and when trouble occurs, I ionkey with the steam end until I have tried all emedies, unless indications are so strong that ible is in the steam end that there is no doubt

W. H. Carpenter.

Deception.

of the Engineers' Review:

ngineer in charge of a valuable steam plant trusted by his employer, protected by license id has by years of hard work and study gained ation, can ill afford to practice deception. It ecessary for him to do so if he is a competent eaded man. There is a certain dignity about l he will fight for his rights, has no fear of his r, and does not have to use deception about k.

is another class of men found at times in rooms. Men who took the jobs on their nerve, ncoed some owner into paying them a salary, pose license laws because they cannot pass an ition, who run their plants for a time and then nts run them. These men must practice de- They lied about themselves when they took They have their little excuses and make be- hile they hold the job, and without doubt the , the baker, and the candlestick maker can testi- ieir qualities of deception when they leave the

ading over the cases mentioned I fail to find a which the engineer was warranted in practicing on. The excuse seems to be that the engineer ced by the ignorance or stubbornness of some , which, you understand, lifts the real blame ie shoulders of the engineer and places it on or soul who was born that way.

fact that the engineer wilfully and willingly d is surrounded by a mass of evidence, and it is act our attention from the real point of issue are told about the cranky, ignorant, or stub- her man. The engineer who attempts to com- shortcomings of the other man by deception imself at a disadvantage. As long as he keeps hands clean he has the advantage. When he em in the mire it becomes a case of the pot the kettle black.

e a successful engineer a man must develop a ability to deal with human as well as mechani- blems. The skilled mechanic uses clean, sharp tools. He does his work carefully and to the n dealings with men you will not find the is forsaken nor their seed begging bread.

W. A. Torrey.

Deception Again.

of the Engineers' Review:

e been reading a great deal lately about the of deception and I would like to say a word ng the deception of D. Parker which he practiced on the unsuspecting Graball. The idea of an engineer with a reputation at stake to go and stick a plug without the composition in it into a boiler, just to hold his place and not only risk his own life, but many others and then call it a little joke on the boss and say it might be called deception.

I call that the rankest kind of deception and I think if the firm that made him the offer knew of that piece of work, they wouldn't want him around their plant. I have had some experience with that Chicago river mud and know the risk Mr. Parker ran in doing as he did.

I have used deception, but in a different way than that. I once ran a plant in Iowa and there was a warehouse and glazing room across the street which was heated by live steam. The men were always kicking because I didn't give them steam enough to keep them warm so I changed the pointer on the gage on that line and made it read 30 pounds and had some of them come over and see. They were always warm after that, though they didn't get any more heat. That was deception, but did no one any harm and did me a lot of good because my five boilers were taxed to their capacity anyway.

B. L. C.

Does Not Believe in Deception.

Editor of the Engineers' Review:

It is with much interest I have read in recent issues of the Review the numerous accounts of deception practiced by engineers, and although they are frank in admitting their deceit, I must say I am surprised to learn that so many would deceive their employers. As W. H. Wakeman says: " It is entirely wrong to deceive the man who has trusted you and paid you for your honest service." There is a way for every man to get over his troubles without deception or dishonesty and in the end, truth and frankness will prove the better way.

I do not consider myself an angel or by any means perfect, but this is how I overcame a difficulty similar to some of those described. Connected to the power house of which I am in charge are nine greenhouses fed through a 5-inch main, running from the exhaust tank, on the end of which is a gage. The foreman of the houses got it into his head that nothing less than 5 pounds pressure would do his work, while I was convinced that 2 pounds would give circulation as it had heretofore and was doing at the present time. Now instead of doctoring the gage by setting it up to 5 pounds and still carrying 2 pounds, I went to my employer and explained to him in a frank honest way, that I did not want to carry so much back pressure on my engine when less would do the work, and that I thought they were running those houses by the gage instead of the thermometer. We decided to remove the gage entirely and then if the thermometer would not register the desired degree we would raise the pressure. So one night the gage disappeared and all kick from low pressure went with it.

Don't you think that better and more manly than it would have been to have doctored the gage and then had the boss come around and ask why I carried such high back pressure and then had to lie to him or own up the whole thing?

In one plant I ran my engine until 10 p. m., and would leave the glass full of water and a good fire with the draft closed in charge of the night watchman, and as he had to use a little steam through night, he just kept steam till morning with the pump working on the returns. I left one night as usual with water just showing at the top of the glass. In 20 minutes the night watch came after me and told me something was wrong. I went over and discovered the building full of steam and a hissing roar coming from the direction of the pump. Groping my way in the dark I at last reached the pump and closed the discharge valve, when the sound stopped. I then inspected the boiler, but could get no water from the lowest point of opening. I quickly covered my fire with damp ashes and closed all connections leading from the boiler, and here is where opinions may differ. Some would say reduce the steam pressure by letting it escape, while others would say hold it in. I am of the latter opinion, as no damage was done, although there was only 8 inches of water left.

The trouble was the check valve had failed to seat, throwing the boiler pressure on the pump cylinder, which had blown the packing from between the covers of the pump, allowing the boiler to empty itself.

M. E. Webber.

Has Charity for Some.

Editor of the Engineers' Review:

The letters relating to the question of deception are interesting, but are not what would be taught in a Sunday school by any means, if we can go by the way the question appears to us after reading from one side of the question only. It is a very easy matter to misunderstand the circumstances of a case, and therefore it is a very easy matter for one to form a wrong opinion of a case when all of the particulars are not given.

Now take the case of the letter "Deception in Engineering," written by S., and appearing on page 21 of the December issue. I would have condemned his way of doing things as much as the next one if I had felt like doing so, and I will say even now after reading the inside facts of the case as printed in the February issue on page 15, that I don't think there was any call for reading the water meter on the other engineer's shift. I think I would have allowed the firemen to use what water was necessary, and had it out with the office if it came to that stage of the game.

Neither did I approve of S. going into the other man's plant and doctoring the valve, but from the letter which appeared in the February issue, I am not sure but what S. did what was the best for all concerned, especially for the old man who operated the pumps. After reading this letter I thought it would be a good idea to look up the letters which had already been written on the subject. This brought me to Mr. Wakeman's letter, and from it I gather that he has never deceived and would not do so under any circumstances. This is a commendable stand to take and I heartily approve of his advice, but I would like to see the man who has never deceived in engineering practice, in some way or other; such an individual would be worth going some little distance to get a view of.

I think Mr. Wakeman is a trifle harsh in his judgment as to the penalty that should have been dished out to S. for removing that valve seat, and I think he will admit so himself, although I have noticed in several letters he has written in reply to others that he says what he means and means what he says, which is in substance the same as saying that it won't make any difference as to what new light is brought to bear upon a subject, he won't be convinced anyway.

It seems to me that S. scores one when he says his conscience would allow him to deceive the company, but could not allow him to deprive his firemen of the privilege of using water to cool the red hot clinkers while cleaning fires, and cleaning fires five times in 24 hours. Perhaps it has been so long since Mr. Wakeman cleaned fires that he has forgotten all about how hot those clinkers are when they are pulled out on the floor, especially if the fires are forced, which makes it all the harder for cleaning, or perhaps when he cleaned fires they were not worked so hard but what they could burn out entirely before cleaning; if so, he had a snap considerably different from what firemen find today, or my firemen at least.

I know that if the firm for whom I am engineer attempted to restrict me in the use of water in the fire room, or anywhere else for that matter, we would have it out right then and there, because I haven't forgotten how hot clinkers can come from a furnace and how disagreeable it is to have dust flying all ove the boiler fronts, let alone the inhaling of it into th lungs. Although I don't agree with S. in his deception as practiced, I say good for him in thinking o his firemen rather than the few cents that might b saved by such niggardly policy as the company trie to impose upon the fire room force. I don't boas much on being a philanthropist, but I believe I woul have paid for that water myself rather than hav compelled the firemen to go without.

It also seems to me that another point is score when we come to the case of the valve in the wate pipe. What would have been the result if the chie had been informed of the refusal of the old man t allow enough water to flow through the pipes to kee the cylinder of the compressor cool. He would hav probably been discharged or have received such a calling down that he would have had it in for S. as lon as he remained in the plant. By fixing the valve without the other knowing anything about it, he saved th old man and undoubtedly prevented a lot of har feelings. Such actions as that hardly call for a stat prison sentence as advocated by Mr. Wakeman. W are told that honesty is the best policy, and we kno it is, but we are also told that of two evils to take th lesser.

A. C. Streckfus.

Piping Kinks.

Editor of the Engineers' Review:

Sometimes it is necessary to run a steam pipe i places where it is likely to freeze. Our method f preventing such pipes from freezing up, is shown i Fig. 1, which has worked to our entire satisfaction.

We also have a cistern which is covered over an filled with hot water and steam, making it impossibl to sound the depth of water with a rod, on account the rod being wet by the steam as well as by the wate This we overcame by dropping a pipe through t cover almost to the bottom, the lower end of the pi being water-sealed. Thus we are able to sound t depth of water by dropping a rod down inside the pip

Your correspondents have much to say as to the value of a technically educated man over the practical or shop-trained man, and it seems to me that they miss the main point in their argument, pro and con. That is, that the man of brains is going to make his mark whether he be school-trained or shop-trained. It is useless to send the boy to either the shop or the school and expect results if nature has not endowed him with the necessary amount of gray matter and ambition. There are qualities necessary to success that no amount of training can give.

I have been a subscriber to the leading engineer's papers all my life, and I have quite a number of gray hairs now, and the same old never-settled questions are still being debated. One is, where is the best place to feed a boiler? Another, what is the stress on cylinder-head bolts? Also, whether compression is a benefit considered from an economical point of view; and I might ask, what makes geese walk single file, but I had better leave that out.

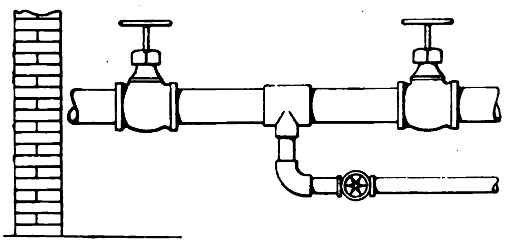


FIG. 1. DRIPS TO PIPE LINE.

Many of us are troubled with our steam pipes vibrating. This can usually be overcome if we have heavy walls and buildings to guy to, but occasionally we haven't. Having a little time the other day, I investigated this vibration, and found that the amount of steam contained in this particular pipe and flowing at the rate of 100 feet a second would exert a force or blow equal to about 400 pounds when stopped in .3 of a second. Two hundred of these pulsations per minute are quite enough to make a pipe dance.

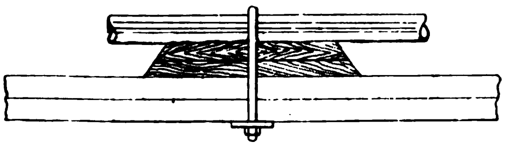


FIG. 2. PIPE LINE CLAMPED TO WALL.

A good method of clamping a pipe when it runs close to and parallel to a wall is shown in Fig. 2. The broad base given by the timber between the pipe and the wall prevents any pivot action of the clamping device. Saw Mill.

Pipe Bending Device and Steam Muffler.

Editor of the Engineers' Review:

It often happens that an engineer wants to bend a pipe, and the only way he can do it is to use a vise. When the job is done it is not fit to put up, as the kinks are enough to spoil the looks of the piping, and a bad piece of piping is what an engineer does not want around his plant.

A pipe-bending device which anyone may make, is shown on Fig. 1. The rib *D* is to hold the plate *C* in a vise, while the studs *A* and *B* are to bend the pipe between, by prying in the direction in which the pipe is to be bent. The stud *B* is fastened to the plate *C*, while the stud *A* may be moved in the slot to vary the radius of curvature. If care is used, the pipe may be bent to almost any shape without buckling.

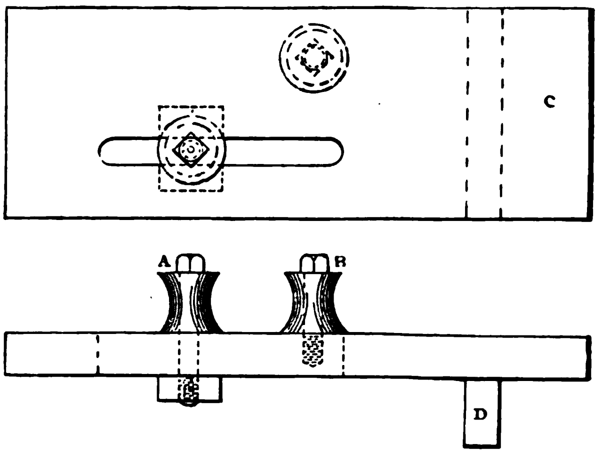


FIG. 1. PIPE BENDING DEVICE.

In our plant we are obliged to heat a great quantity of water in tanks, and the way this was originally done would almost cause one to think that the bottoms of the tanks were about to come out. Anyone who has had any experience in heating large quantities of water in a hurry, knows what a noise and rumbling, trembling sensation it produces.

To do away with this noise, I made a muffler as shown in Fig 2, as follows: A brass pipe *C* is threaded at both ends, one end long enough to allow for the two nuts and a coupling to connect it to the steam pipe. The pipe is perforated, each hole being countersunk as shown at *D*. This pipe may be made as long as the operator deems best. It should be of sufficient dimensions, however, to allow enough holes to amount to about twice the area of the pipe. On each end of the pipe a washer is placed and held in place by jamb nuts as shown at *E E*, the outer end being capped as shown. Between the two washers, the pipe is wound with first a layer of burlap and then a layer of fine mesh brass wire gauze. Brass is used to prevent rust. This forms a spool of a porous nature through which the steam may be driven without noise. M. O. Taylor.

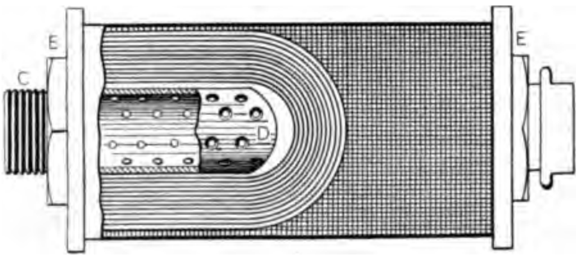


FIG. 2. STEAM MUFFLER.

Electric Telltale and Gaskets.

Editor of the Engineers' Review:

I am a reader of the Engineers' Review and seeing so many good devices published I thought I would send in one. Fig. 1 shows a supply tank which stands 1,000 feet from the power house. The telltale is made up of electric bells and the weight *W*, which is of iron and slides in a slot in a board. To the weight a wire is fastened and run to batteries *A* and then on to the bells *E* and *F*. At both ends of the board on the tank are fastened iron contact pieces *Z* and *X*, to which the wires from the bells and battery are fastened. Now if the weight *W* comes down to *X* I know the tank is full, as when it touches *X* it acts as a switch and rings bell *F*. If the weight *W* goes up to the top and touches *Z*, the tank is empty, for it rings the bell *E*. This arrangement is very handy.

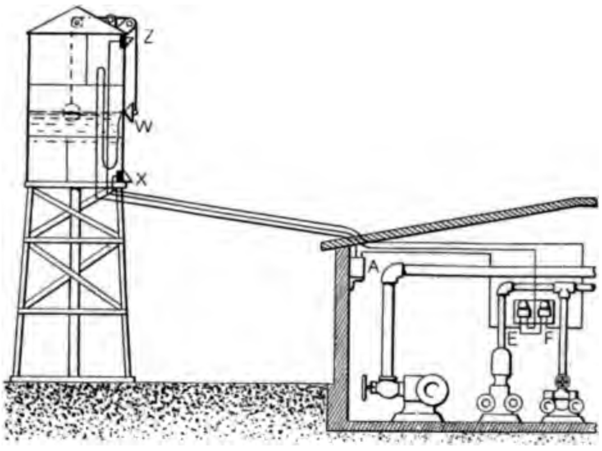


FIG. 1. ELECTRIC TELLTALE.

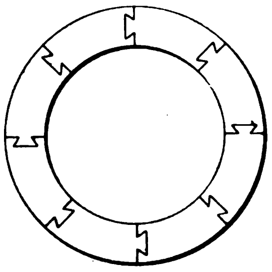


FIG. 2. SECTIONAL GASKET.

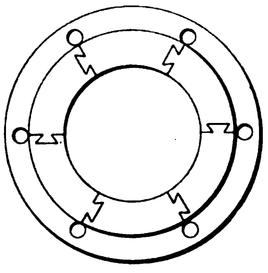


FIG. 3. GASKET IN PLACE.

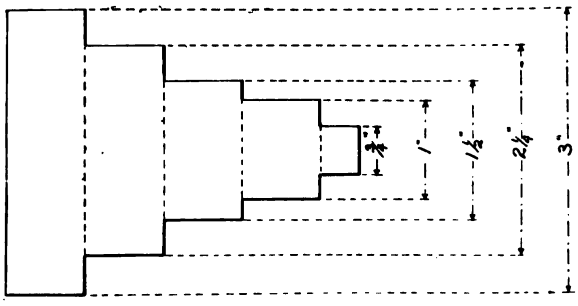


FIG. 4. TEMPLATE FOR CUTTING GASKETS.

The next is on cutting gaskets for large flanges. Fig. 2 shows how they are cut. We first lay off a circle, then divide it into the number of segments that we want and by cutting from a sheet of rubber packing we save considerable rubber. Fig. 3 shows a gasket of this kind in place. Whenever I have a gasket to cut for a flange I cut it to go inside of bolt circle.

The next, Fig. 4, is a template for cutting rod packings of all kinds. It is made of wood turned down to the diameter of the different rods we have on our engines, pumps, etc., so if we want to pack our piston rod on the engine and it is 2¼, 3 or 3½-inches we just run packing around the required diameter on the template and cut our packing the way we want it. The same is done if we want to pack any kind of a rod. Templates of all sizes, even for pipe unions, come in very handy in our engine room, as many times we wish to put a gasket in a small union and it is quite hard to cut them at times on account of the pipe not giving away enough to put the rubber in place to mark it so we can cut it.

If I had my way I would use all ground joint unions for they do not require any gaskets and last for years.

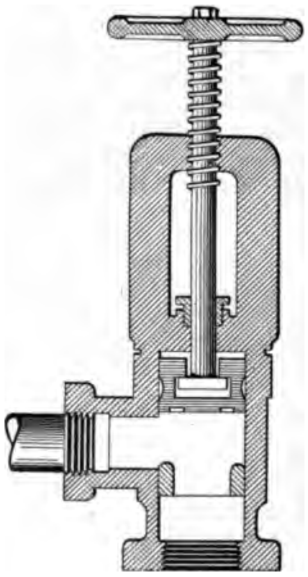
L. A. Cole.

Removable Disk Valve.

Editor of the Engineers' Review:

There has been considerable said, about removable disk valves, in the Review, and I think the advice given by J. E. Noble on page 13 of the November issue is good.

In my present position nearly all the valves have removable disks. I have removable disk check valves and in one the disk has been in use two years and a half and some of the disks in the globe valves have been in use longer than that. In a former plant in another state I could not keep a disk in, sometimes only a week, before it would leak. Wherever they were below the water line they would not last any reasonable length of time and I had to replace them with gate valves, but in the cold water and steam lines I had no trouble.



BLOWOFF VALVE.

I can use them in any place in the plant I am at the time, with good results. While on the valve n I should like to ask other engineers what they ɔf the blowoff valve in the illustration. It will ced that the pressure comes against the lower the valve, as it should, and the seat extends out ıe outlet so that the scale has no place to lodge, l drop down so as not to get in between the seat ık and cause the valve to leak. The disk, there- /ill not have to be renewed as often as in the : make of blowoff valve.

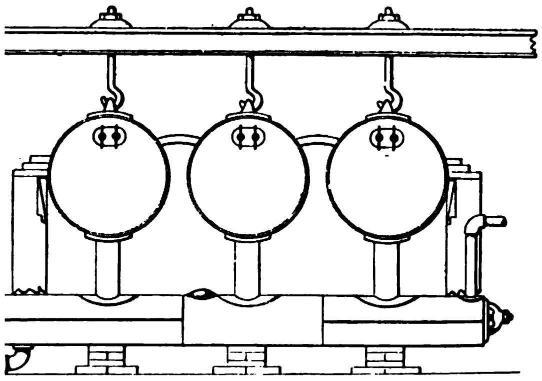
· one am very much obliged to C. B. Risley for er on "How to Pack Asbestos Blowoff Cocks." ɔf us engineers have been sending them to the ; to be repacked and they would charge about much as they cost when new.

A Young Fellow.

What Caused the Bulge?

of the Engineers' Review:

accompanying illustration is of a set of boilers mud drum attached. On the upper side of the ːum near the middle leg at *A*, there is a bulge I cannot account for. The drum is kept clean lly and externally and there is no scale in it.



SHOWING BULGE ON MUD DRUM.

nding with a hammer on all parts of the drum ge, there seems to be no difference in the metal, ; from the sound. The bulge is about 6 x 10 in size, and about 1-inch out. The drum is es in diameter and 22 feet long. Can any of lers enlighten me on this and explain the cause?

F. H.

Cleaning and Banking Fires.

of the Engineers' Review:

:. Garman's letter on page 17 of the January , relating to cleaning fires, will no doubt bring ıts from many firemen as well as engineers who · own firing, of which I am one. Brother Gar- /s of cleaning fires: "I think a better way is to ıck and over, a combination of both methods." ı my mind, is a long and unnecessary way.

. my way while similar to his, it is I think, bet- bout an hour before I intend cleaning I begin ; up on one side, letting the side I intend clean- ı down. Then I get my hoe and bar, similar to ıar, only slightly curved on the end, which I use to shove what live coals remain over on top of my heavy side.

I also have a chute made of heavy sheet iron, the width of my ashpit door and turned up about 6 inches on each side, one end supported on a pair of wooden legs, the other in the ashpit. This saves my floor and the work of cleaning it up. Before cleaning I let my steam run up within two or three pounds of popping, and have everything all ready. Then I slack off the draft, open the door, and after shoving the live coals to one side, pull out the ash and clinkers. If burning hard coal, I cover the bare grate with coal and then push part of the fire from the heavy side over and close the door and open the draft.

My boiler is a 100-horsepower sectional Harrison safety boiler, and usually runs full capacity with 90 pounds pressure, and I can clean one side in five minutes without losing over 5 pounds of steam.

About 15 minutes before shutting down I have the clean side built up and repeat the process on the opposite side. I turn my hoe bottom side up, so that it will not push up over the fire, and push my fire back and smooth over and cover with coal about 3 inches thick. I leave the grates bare for about 18 inches back from the door and when covering the fire cover about half of this with coal. The next morning I have 60 pounds of steam and a good fire as soon as I turn on the draft. I leave the damper open a trifle and all doors shut tight when burning hard coal.

S. Kip.

When an Engine Runs Away.

Editor of the Engineers' Review:

A letter from F. G. Peck, published on page 28 of the December Review, under the above heading, treats on a point that interests all engineers. He asks if the risk is worth taking for an engineer to try and stop his engine when it runs away. He suggests that the engineer, for the sake of himself and family, should also run away as fast as possible and let the machine go to ruin.

There may be times of course, when it is impossible for an engineer to do any good by staying by to take part in the wreck, but those times are indeed few, and an engineer whose first thought is to get out of danger should never work around an engine.

In an emergency of any kind he would be practically useless and of no value whatever. The engineer who is worthy of the name seldom thinks of personal danger and rushes in upon the first sign of trouble. There have occurred hundreds of cases where disaster has been averted and lives saved by alert, fearless engineers who did not hesitate to risk their lives to save their engines from destruction.

My experience has been but very little different than most engineers, yet I can remember many times when my engine has been saved from wrecking itself by simply doing what I was expected to do, and so can every engineer who has been engaged in the business for any length of time. It is impossible for an engineer to tell when the first warning of trouble comes, whether there is real danger or not. So his first thought in every case should be, and usually is, to shut down as quickly as possible.

I think Mr. Peck would be out of a situation very often if he should follow his own suggestions.

I like the letter written by W. A. B. in the same issue, entitled " Engineers Again." It sometimes takes more skill and good, practical knowledge to keep a small engine and boiler in shape to meet the demands made on it than it does to take care of a large compound engine.

I have in mind now a plant where there is a 2,000 horsepower engine. The engineer simply takes care of that machine while the fireman has to look after the boilers, several pumps, etc., and it keeps him hustling all the time. If their positions were reversed I think the fireman would make a far better showing than would the engineer. Yet one man is an engineer and the other only a fireman.

We are always finding new things to learn and new ways of doing the old duties, and that is what makes the business interesting.

Some of the deceptions mentioned by " Grafton " in a recent letter are certainly unusual to say the least. The questions asked by W. H. Wakeman in regard to the matter should set engineers who are engaged in " such so-called sharp practices," to thinking. The honest man will, under all circumstances, be honest with his employers. S. J. Smith.

Bill B. Banger on the Wrench Question.

Editor of the Engineers' Review:

Some how or other things are always coming up to disturb the quiet of my engine room; if it ain't one thing, it's another! The first thing I tried to do in a shipshape way was to write you fellows a letter which used up the best part of a day. Then along came that letter what made me feel so doggone down in the mouth all day, and I had no sooner found my ways again before the matter of deception came up and I had to read the riot act to my fireman. This upset me for several days, and then to cap the whole durned business, the boss came and began poking into things that was no business of his, as I tried to show in the last oration I sent in.

This business of yanking on valve wheels with monkey wrenches or any other kind is all right. I will come out without any kind of holding back in the traces and tell it to the four winds of heaven that I have used wrenches on the wheels of my valves and never broke a wrench doing it in my life, and some of the valves are in use today, although they have been in the pipe line all of 17 months. If it ain't going too far, I might be so bold as to mention the way to use a wrench on a valve wheel, and if you don't get the idea in full then drop a line to me and I'll be glad to go more into details.

I will illustrate the way I go about this simple duty by just telling how the job is done on my 7-inch pipe line. Of course, you will know that the valve is of the same size without me telling you so. I hunted all over the plant for a 6-inch valve, but there ain't any in the place, the smallest being the 7-inch already mentioned. I tried to find the 6-inch valve because everyone tells about the smallest thing they have in their plant, and I wanted to be in line with the rest of the fellows that wouldn't be found having anything to do with deception.

When I go to shut that 7-inch valve I twist up on it as hard as Sam Hill, and then go and get the 24-inch monkey wrench and adjust it so it won't slip off f the wheel, and then I pull for dear life; if I don't the right pressure, I kind of spring on the handle like to know that the wrench is on good and tight cause one time while I was a-hanging on, the bla thing slipped off and landed me all in a heap on floor. That is one of the disadvantages of usin wrench on valve wheels, and one that the boys hav pushed forward yet.

Sometimes when I get to feeling good and st I get a piece of 2½-inch pipe about 4 feet long splice out the handle of the wrench. When I do I feel reasonably sure that the valve will shut tigh something, and if I don't feel it setting down place as it should under such circumstances, I whistle to Tige and he comes and gives me a lift, when both of us get at them valves something happ

If a valve won't stand the monkey wrench treatm it is a sign that it is no good, or that the strain has too much for the stuff the valve is made of, or the metal couldn't stand the strain put upon it. either case, I get a new valve and so help the fel that work making new ones, keep their jobs.

ONE OF BILL'S METHODS OF CLOSING A VALVE

I have found that it don't make any difference a the size of valve; a wrench should be used any that's what they are made for, and what's the us having a lot of tools around a plant if they are n used? If I had a fellow who wouldn't use the inventions of time and labor-savers, I'd feel incline fire him on the spot. What's the use of men sittin nights burning their candles at both ends, tryin find out something that will help their fellow m their fellow men won't appreciate their efforts they are all in?

But to get back to the valve question. I u wrench on my valves because I'm afraid they get to leaking if I don't. Now, what's the use of ting a lot of new valves and let them get to lea the first thing when all that is wanted is fo who is running the place to get a good sized y wrench and use it to the best of his strength ility. I have seen fellows put in new valves ver think of using a wrench on them, but that they ain't got much sense, or if they have they se it. Them same fellows will shut their valves d, and if they don't shut tight and leak after g they will go to all the bother of putting in isks, and sometimes I have known of some of going to the expense of getting a machine for ng their valves. Now, I call that the height of se and twice as foolish; it is a pretty sure thing on't read the letters in the papers or they would ound out that valves can be closed with wrenches, a wrench won't do put a piece of pipe on the and pull for all you're worth.

tice that most of the fellows are running their with what they call high pressure steam, and of them go so far as to say right out that the re is as high as 150 pounds and kind of intimate is harder to shut a valve tight on a high pres- han on a low. Well, I suppose it is, but if the y wrench is used there will be no trouble unless med thing gets to leaking. I kept watch of the gage in my plant for several days so as to be bout the pressure carried, because I didn't want ke any rash statements about the matter, but I out after careful thought and consideration, as ay, that we was carrying a reasonable high pres- s the gage mounted right up to 160 pounds all ne. All the difference I can notice is that we to use a larger wrench, but the principles are ne with all valves, the larger the valve the larger rench to use.

ve got the thing down to a science and have a kind of wrench for a certain size of valve wheel. for instance, if the valve is only a ¼-inch I don't wrench any larger than I can get in through the in the wheel, but it must be remembered that ll valve wants the wrench cure just the same as ther valve. The larger the valve, the bigger h I use. The boss is figuring on putting in a d a 14-inch steam line, and as I ain't got any h that will fit the wheels I suppose I shall have a couple of larger ones, or give up my system. uestion of using wrenches on valve wheels is one tty big proportions and one that is taking up the f some of the brightest lights in the engineering and what the ultimate, final and irrevocable ver- ill be is known only to a few of us engineers ave practiced what we have preached and know of we speak.

Bill B. Banger.

Too Much Compression.

of the Engineers' Review:

ave had troubles something like that O. E. W. ns in the Review on page 16 of the February r, and I have found in some cases that the trou- s caused by having too much compression either end of the cylinder or the other. The indica- from what I am able to gather, are that his had altogether too much compression. I ar- t this conclusion from the fact that his engine ll right and is noiseless when the steam pressure o 100 or 110 pounds.

When the steam is down to say 75 pounds, of course the load is the same and therefore that factor will remain the same, but if the load is decreased, the compression becomes greater than when it is heavy. When the engine is operating with a pressure of 75 pounds there will probably be a pressure of about 70 pounds at the engine, the loss being due to the length and design of the steam pipe line. If the valve is so set that the compression line, as shown in a card, runs up to a point higher than the steam line showing the boiler pressure, there is nothing to prevent the valve from lifting from its seat and giving out a clicking sound, which will many times sound like that caused by water. When the pressure is raised to 100 or 110 pounds the compression, although it may remain just the same, will not come up as high as the steam line denoting the pressure in the boiler. Then if this is so the valve has more pressure on the outside than there is on the side next to the cylinder, and therefore does not lift from its seat, but the compression is there just the same. I think if the valve is set to give less compression the trouble will disappear.

There is, however, another reason why the clicking appears when the steam pressure drops to 75 pounds. It may be caused, as the writer says, by water, but as he says he has opened the drain cocks for water and finds none, it is possible that this second cause is not the real one. Steam at 75 pounds would naturally be of a wetter nature than steam at 110 pounds, and if the difference is enough there will be ample reason for the water to form in quantities enough to cause the clicking and to disappear when the steam is at the higher pressure, and therefore hotter in temperature, consequently having less tendency to condense.

The letter by F. L. Johnson comes pretty near right when he says that if compression costs anything, it costs too much. If the compression in the engine operated by O. E. W. is the cause of the trouble, it is enough to be of an expense to the plant, and, therefore, should be got rid of as soon as possible.

I don't fancy the admission lines of the cards sent in by Mr. Johnson, and it seems to me that there is a loss of energy by allowing the admission to occur so late in the stroke. It looks to me as if it were a case of economy in the compression at the expense of the admission. If the compression could be kept down, and the admission line allowed to run straight up as it should, and at the same time get a smooth running engine, I should think that a little compression is a good thing. For my part I have never been able to get along with as little compression as shown in the cards and at the same time have the steam valves open at the right time. How about it, Mr. Johnson?

F. Davis.

Back Pressure.

Editor of the Engineers' Review:

Some time ago the subject of overloaded boilers came up and was discussed a little, although nothing definite was decided as to what constitutes an overloaded boiler. In the letter by I. B. Harland, on page 25 of the February number, is given a case of an overloaded boiler, where he gives an account of how an attempt was made to make two engines do the work formerly done by one engine, and which ended in failure. If one engine would do the work, but the boiler was not equal to the demand put upon it there was not very much figuring necessary to show that two engines would eat up still more steam. I don't see how it could be reasoned that the two engines would do the work of one on the same boiler capacity and at a lower steam pressure when the boiler would not make enough steam for one engine. If the engine had been the one to be overloaded then the remedy would have been all right and they would have got results, but it is evident that they forgot that it takes more steam to operate two engines than it does one and that two engines will have just about twice the amount of waste going on in the cylinder than in the case of one engine. The friction is also twice as much, and it is no wonder the trial ended in failure.

Going back a little in the same letter, we have an account of how an exhaust pipe 175 feet long did not have any back pressure on it, and this fact was proven by a steam gage which was put on the pipe. It has occurred to me that the gage might have been a little out of order. I had a similar case only the pipe was not so long. When I put one gage on the line there was about 3 pounds back pressure, but when the other gage was put on there was nothing showing. This was evidence that there was something wrong with either one or the other of the gages and when they were tested it was soon proven that the gage which had shown a pressure was the one which was right, while the other was wrong.

If Mr. Harland thinks there is no back pressure caused by that length of 175 feet in the exhaust pipe, he will find he is considerably off in his reckoning if he will put an indicator on the engine, and then measure the back pressure. I have seen but one card which showed no back pressure on the engine, and I won't vouch for that one as I did not see it taken and am not sure but that it was a doctored card. The lowest I ever got out of any engine I have operated was 1½ pounds back pressure, and I thought I was getting about the limit. If an indicator don't show that there is back pressure on his engine I will take off my hat to him the first time we meet.

I want to take up the cudgel with J. E. Noble as to the practice of leaving the furnace doors open at night. It is not only wrong theoretically, but it is wrong practically. It has been proven too often for there to be any doubt about the matter. This is brought out more in locomotive than with stationary practice, and examples of what leaving the doors open will do, are well illustrated in the case of switching engines which are worked hard for a while and then allowed to stand idle. The fireman, in order not to have the safety valve blowing off all the time, opens the door and in the larger number of switching engines the tubes leak. It is brought about by no other reason than that of expansion and contraction. There are exceptions to all rules and the boiler he calls attention to is, in my opinion, the exception, because I can point out so many cases where boilers have had leaks because of air striking the surfaces, which were stopped when the engineer found out what was causing the trouble. If a man keeps the furnace doors shut all of the time he will be on the safe side, and as there is no reason why they should not be closed at night, there is no excuse for keeping them open. D. Parker.

Compression of Steam in Cylinders.

Editor of the Engineers' Review:

After reading the letter by F. L. Johnson in
February issue I reread the letter by W. J. D. to wh
he refers and could not find much information as
whether the engine he has is economical or not. l
Johnson says that if the compression costs anything
all it costs too much, and that if the engine is in l
and the bearings are adjusted properly there is no n
of compression.

I am well aware that Mr. Johnson has argued on t

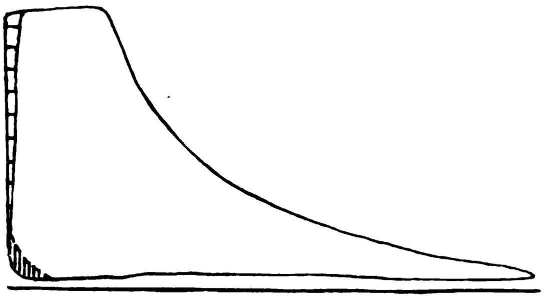


FIG. 1. SHOWING LATENESS OF STEAM ADMISSIO

point for sometime in other papers, and has always c
tended that the above was correct, but I have not s
any of his cards before, and before looking at th
shown in the February issue I had not thought m
of his method of operating an engine without compr
sion. Supposing he uses a 60 spring, which is ab
what is required in a plant the size I understand M
Johnson to work in, where a steam pressure of 1
pounds is carried; it will be seen that the piston h

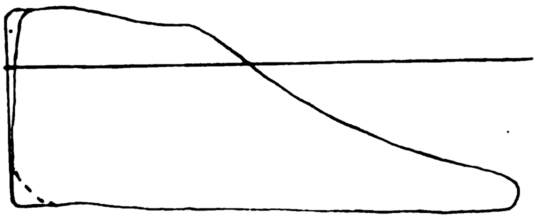


FIG. 2. SHOWING SAME ON LOW PRESSURE CARD.

traveled 4 inches on its stroke before the steam h
a chance to do any work. I could not see where the a
vantage came in, because I thought what he gains
the absence of compression he loses in the lateness
the admission of steam to the cylinder.

He has given me a new idea, however, because
will be seen that if the space which shows a laten
in the steam admission is measured the area is ab
.28-inch. The area of the space which would be tal
up by compression measures .33-inch. This sh
that the compression is costing a little more than
lateness in the admission of steam in the cards sho
but it is evident to every engineer that the compress
as shown by the dotted lines, which is an imagin
line, is less than is the practice of most engineers
carry. If the slight compression which is shown
the diagrams is causing a greater loss than that cau

by the lateness of the steam, it is evident that in a good many engines the loss of compression is far more than is usually credited. The compression line only extends upon the diagram about 1-3 the height, while the greater number of diagrams will show that the compression line extends up a good 2-3 and sometimes more. It is evident, therefore, that the above diagram is as favorable to the side of no compression as any could be.

It is as Mr. Johnson says, steam is used in the cylinder of an engine to turn the shaft, and all steam lead tends to the opposite. I would like to have him show us some of the cards he has taken of engines which were running as the greater number of engineers run them, and then show cards of the same engine after setting the valves. Such a demonstration would do more to show up the advantages or disadvantages of his way of doing it, than all the arguments that could be printed in the Review.

I think it would be a good idea to give a little data as to the cost of operation both before and after the valves were changed. Then we fellows who are looking for a better way to operate our plants would have something to go by as a guide, and would not be working in the dark with the chance of making an excessive cost of operation while the experiment was going on. I, for one, would like to hear more about the results obtained from operating an engine with no lead and little if any compression. T. P.

Compressor Diagrams.

Editor of the Engineers' Review:

The compressor cards shown on page 28 of the Review for January, bear some earmarks of having been homespun. For instance, both cards of the pair are too near alike. The expansion curve is a 90-degree arc with a ½-inch radius, while the compression curve is composed of only two arcs and a straight line ½-inch long. In running theoretical lines over the cards, it will be seen that the compressor is delivering about one-fourth too much air, and this too, without clearance or leakage. With a 77-pound gage pressure, it is probable that the card was taken with an 80-pound spring, for it is just 1-inch high. Now calling the air pressure 84.7 pounds absolute, the atmosphere 14.7, both at the same temperature, we have $14.7 \div 84.7 = .173$, the part of the stroke that the piston would force air into the delivery provided there was no clearance in the cylinder, no leakage, nor change in the temperature of the air being compressed. Jack's, Fig. 2, cards are shown in my Fig. 1 herewith, worked up as stated above. The needle-points at the top of his Fig. 3 cards preclude the possibility of their having been made with an ordinary indicator, under the conditions he gives. One of the peaks leans to the left, showing that the paper drum moved backward as the pencil went up.

I would not have any one infer that I censure Jack for sending these cards for publication. Someone should cut bait for the other fellows' think traps occasionally.

In sending indicator cards, all of the important data concerning them should be furnished, so one can determine just what the diagram represents. The scale of the indicator spring, the clearance volume, if known, the diameter and stroke of the piston, and speed of the engine. My Fig. 2 shows a card, and how it may be worked up.

The full lines represent the indicator card. Tack it to a board, then with a square, triangle and rule, draw the vacuum line 14.7 pounds below the air line, to the same scale as that of the indicator spring. Set up the clearance line at the right, and draw a line parallel with the air line, at the top of the card. Then draw a line parallel with the clearance from *A*, the terminal pressure of the expansion line. The location of *A* is not very particular, just before the exhaust opens being about the best place. Draw a diagonal line from the upper left-hand to the lower right-hand corner. From *A*, draw a horizontal line till it cuts the diagonal line at *B*. A vertical line from *B* locates the point of cutoff. From points along the top line, as 2, 3, etc., drop vertical lines, also from the same points draw diagonals to the lower right-hand corner. Now from where these diagonals cross the vertical cutoff line draw horizontal lines to intersect the vertical lines from 2, 3, etc., then through these intersections draw the expansion line, all as shown in Fig. 2. It will be noted that the theoretical and actual cards do not agree as closely as they might. The reason is that the piston leaks badly, and the expansion line falls below where it should on that account. If the steam had not leaked out, the terminal pressure would have been higher, which would mean a later point of cutoff in the theoretical card.

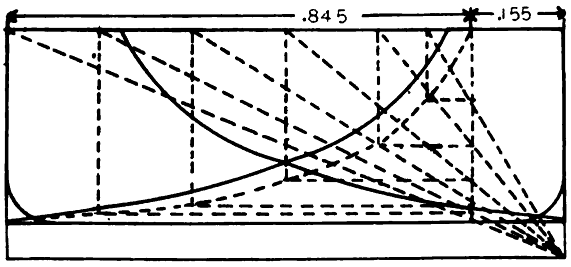


FIG. 1. COMPARISON OF THE ACTUAL AND THEORETICAL EXPANSION LINES.

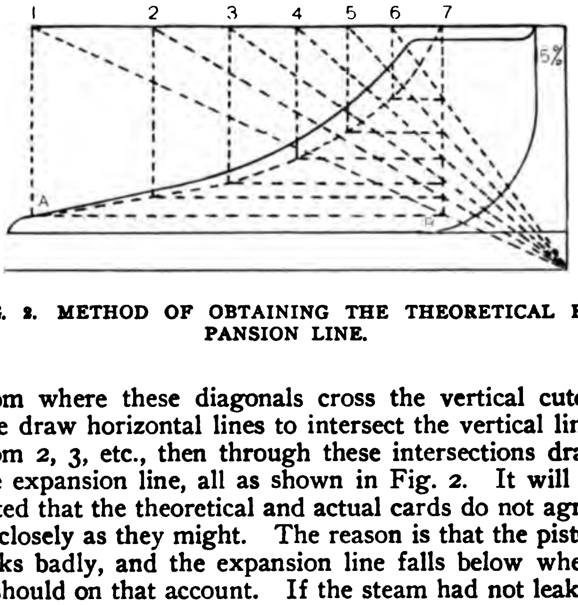


FIG. 2. METHOD OF OBTAINING THE THEORETICAL EXPANSION LINE.

In Jack's card Fig. 2, if the air was not cooled, its increase in temperature, due to compression would make the theoretical and actual lines agree very closely, but he tells us about his water jacket, and may have forgotten it when he made the cards.

Duffy Price.

Taking Up Lost Motion.

Editor of the Engineers' Review:

The discussion that has been going on between Mr. Wakeman and others regarding the travel of the piston which incidentally brought up the question of lost motion, which of course was what brought about a necessity for keying up the brasses, has suggested to me that a short letter on taking up lost motion might not be out of order at this time. It is of course, one of the natural outcomes of cause and effect and no matter how well built an engine may be or how well taken care of, the necessity for the taking up of wear in various bearings will occur sooner or later. The various types of bearings cause the method of procedure to vary and the size also affects this point. The object is to make a bearing so tight that it will not pound and yet allow it to remain sufficiently loose so that there is no undue friction to cause heating. These are the points between which an engineer must work, *i. e.,* he must adjust his bearings so as to eliminate all pounding and at the same time avoid heating.

I have found in my experience as an engineer that a good method of testing the adjustment of bearings is to take leads from it and measure their thickness after the caps have been set up tight on the distance pieces and liners on either side. This method would apply to the bearings illustrated in Fig. 1. In order to carry this method into operation, the bearing cap *A,* should be removed, leaving the journal bare as shown in Fig. 2. Then place the pieces of soft lead wire across the journal as shown at *B, C,* Fig. 2. This lead wire should be about 22 gage and two pieces at least used and sometimes three, when the bearing is a very large one. After the wires are laid across the bearing as shown, the cap *A* is replaced and the nuts on the studs set up as tight as possible without using undue force. Then their positions should be lightly marked by means of a center punch so it will be possible to return them to their position later on. The next thing is to unscrew the nuts and remove the cap and wires which will be found to have been crushed into thin lead ribbons, the thickness of which is a measure of the amount of play between the journal and the brasses. These lead ribbons are then measured by a wire gage and if the shaft is 12 inches or more in diameter and does not revolve more than 125 revolutions per minute, it is safe to allow a thickness of lead of from 28 to 30 gages. When the shaft is smaller and the revolutions greater, the thickness of the ribbons should not be less than 32 and even as high as 34 gages.

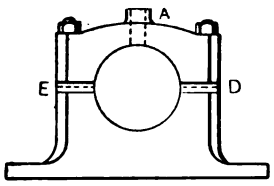


FIG. 1. END VIEW OF BEARING.

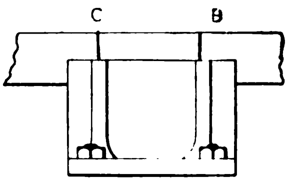


FIG. 2. POSITION OF WIRES.

It is advisable to carefully examine the leads with the gage to see if they are of uniform thickness. If they are thicker near the ends than at the middle it is evident that the bearing is not as close at the sides as to the bottom, which shows that matters are as they should be because bearings that are close at the sides tend to increase the friction. If the leads are thinner at the sides than in the middle they should be cut away and if the leads are too thick in every part a liner should be taken out at each side, to allow the bearing caps to come closer together. These liners are always placed on top of the distance pieces, Fig. 1.

In boxes and bearings of all kinds it is advisable to use distance pieces and liners because when no distance piece or liners are used, as the brasses wear thinner the edges must be cut away, which requires careful work, or the brasses must be allowed to have some play in order not to bind the pin. With a distance piece and liners this is all avoided, as adjustments can be made by simply removing the proper thickness of liners and when wear necessitates it, the distance piece can be made thinner and the same operation repeated. In taking up bearings care must be exercised not to change the length of any of the reciprocating parts, as this will, in the case of the crankpin and wristpin change the path of travel of the piston, and in the case of wristplate and valve gear change the action of the valves. D. O. Kennedy.

More About Piston Travel.

Editor of the Engineers' Review:

Having become interested in the argument of changing the piston travel, I thought I would chip in. Mr. Henderson says he has charge of engines where he has put in ⅜-inch shims to make his engine travel evenly between the heads. I would like to ask the gentleman if he changed the length of stroke or the length of his connecting rod? I think it was the latter and if he will stop to think, he will remember there is no exterior part on the engine that will change the length of stroke and the same thing for which he used shims can be accomplished by changing the position of the eccentric collar, as the fault was there and not in the brasses. While Mr. Wakeman and I do not agree on all questions he is right when he says the piston travel can not be changed outside of the cylinder and not there either without changing the length, of the cylinder. J. T. Welsh.

Clearance and Travel.

Editor of the Engineers' Review:

Allow me a few lines in reply to the letter of Mr. C. G. Stockwell in the January issue.

Some time ago I saw a letter in your paper from an engineer who claimed to have changed the travel of an engine piston. As this was interesting I read the letter, but found he had not changed the travel at all, but had only changed the clearance.

This again called my attention to a matter that needs a remedy, for engineers are too much inclined to say or write one thing when they mean another. Any discussion which calls attention to this evil is not without substantial benefits to all concerned. If we mean clearance we should not say travel, expecting others to understand what we mean.

Mr. Stockwell has made a mistake in his letter which

corrected. He says, " It appears to me that
r is wilfully ignoring a fact that he knows as
do, that the travel of a piston does change, as
es are worn and keyed up." Now, I cannot
him, but can for myself, as I know that such
lified statement is not correct. There is an
ear my desk, as I write, in which adjusting
ecting rod brasses for wear neither changes
l of piston nor the clearance of engine.
er to make it still plainer, I will say that ad-
hese connecting rod brasses does not change
nce between the centers of the crank and

Mr. Stockwell and Mr. Geo. Henderson, on
of the same issue, have evidently made the
take, for they take a few experiences with a
ind of engine, and on them base a cast iron
ch cannot be applied to hundreds of cases
practice, and this I object to as being un-
to all concerned.

up both ends of a connecting rod will change
ance in some cases, but does not in others,
it is not practical to lay down one rule for all

a writer states that a subject presented in an
ng paper results in benefit to no one he has
tatement that it is impossible to prove, for the
ason that he cannot get the opinion of every
While a subject may be old to some readers
irely new to others. I am inclined to think
the matter under discussion is interesting to
kwell, for a man does not write a letter like
s he is interested.

ever occurred to him that it would be very
to discover a subject new to everybody, or
ajority of well informed engineers have not
many times?

e sure that Mr. Stockwell can write on sub-
t will interest, benefit and amuse us, therefore
ve something from him along these lines, and
f it savors of " hash " we will remember that
used in very large quantities and probably
vill be.

also carefully read the letter signed " S." in
uary issue, and when viewed as a document
to distract attention from the real point at
ertainly consider it a masterpiece.

never written one line in favor of allowing
to suffer for lack of water, and never intend
ve written several lines in favor of an engi-
lering true reports to the office, and still main-
it is the only proper way to do. False reports
deceive an employer are not justifiable.

man that I have known to be caught in a
transaction had some excuse for his acts,
everything is done on an honest basis, no
re called for. I have been a close student of
er for 30 years, and I have never known one
to lose his situation because he was honest,
ny have suffered because they were not per-
nest.

sixth paragraph, on page 15, " S." says,
r. Wakeman answer me that and not evade
either."

uestion that he asks has no bearing whatever
int under discussion, but I will answer it fully.
If you are running an air compressor that requires water, and you do not give it enough, the machine will be ruined.

I put in the proviso that it requires water because I am running one that requires none.

In the seventh paragraph he asks, " What was I to do?"

I will answer that, too. The proper thing to do under such conditions is to report to your employer that you are not getting water enough to insure the safety of your machinery. After such a report is once made and understood, it clears the engineer from all blame in case of accident, provided lack of water is alone responsible for damage to the plant.

I will go further and state what he should not do. It is not proper to enter other people's premises and disturb or take away their property. In case of a steam plant the removal of a small part that might not be worth more than 25 cents, (without the engineer's knowledge,) might cause a loss of several hundred dollars and endanger one or more lives, hence anybody caught in the act should be severely punished.

Having made these positive statements I wish to offer an opinion for what it is worth. If " S." will carefully analyze his feeling in the matter he will find that a desire to circumvent the old man in charge of those pumps, and so get the best of him, had more weight in deciding what was to be done, than a desire to shield him in his disagreeable conduct.

As a rule we are not endangering our own reputation for the sake of somebody who is doing what he can to make life miserable for us out of pure cussedness. Had " S." simply reported the matter, that engineer would have been ordered to run those pumps faster to supply what was wanted, and that is all there would have been about it.

This answers the questions that have been put to me, but if I remember correctly I have asked one or two that have been entirely ignored.

W. H. Wakeman.

Engine Governors.

Editor of the Engineers' Review:

One or two writers of letters in the Review have lately touched upon the subject of engine governors, not so much in their design and operation, but upon troubles that have been encountered. This letter is not intended as a description of the operation of engine governors nor the principles that cause them to do their work, but is for the purpose of calling attention to some of the causes which hinder them from bringing about satisfactory results.

As a general thing it will be found that worn pins, dirty joints and stopped up oil holes are responsible for many governor troubles. When this is the case the remedy is to clean them up and keep them clean and this is easily done by oiling them copiously with kerosene oil.

The careful engineer will examine his governor every time he has occasion to wipe down, which should be at least once a day where the operation of the engine permits it. By doing this he stands a pretty good chance of discovering any defect that may exist, and by keeping his governor clean there will be no danger of its becoming gummed up. This applies also to what is known as shaft governors with the exception that the shaft governor should be examined more minutely because, as a rule, there are more working parts, and they are harder to clean and get at. They are of necessity under more tension because they must move the cutoff valve to meet changes in the load and this sometimes requires considerable force, notwithstanding the fact that such engines are supposed to be fitted with a balance valve of some kind.

Some engineers are in favor of using heavy rubber buffers which assist in bringing to rest the parts of the governor which are controlled by either the spiral or flat form of spring. This is to resist the excessive shock which often occurs.

Engineers are often unable to discover wherein the trouble lies and therefore condemn the whole machine as being a poor design and not fitted for the work it is doing. This in some instances is undoubtedly the cause, but not in engines which have been manufactured during the last 10 or 15 years. Today if an engine does not come up to its requirements it is a pretty sure thing that the trouble lies in the governor.

I know of an instance where an engine of the upright type rated at 350 horsepower would run away when the load was thrown off suddenly if the engineer was not at the throttle to throttle it down. Although the speed was governed very satisfactorily during the run when the load was anywhere near constant, it was not good enough to come up to the contract agreement. Examination of the governor showed that the trouble lay in the fact that it did not have range enough, consequently it was unable to cut off the steam early enough in the stroke to prevent the engine from running away. The first time this happened with me it nearly caused my hair to rise off the top of my head.

To show the difference in governors, the one which was on No. 3 engine, of the same type and design in every detail, as far as I could see, would govern the engine from no load to 15 per cent over load with a change of only two revolutions, and this was accomplished time and time again. When a governor will do that it is about as near a state of perfection as it is possible to get it.

F. S. K.

Water Tank Piping System.

Editor of the Engineers' Review:

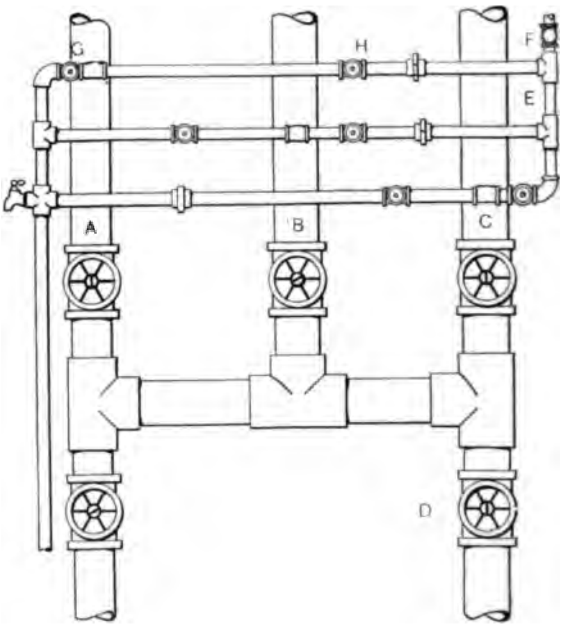
Where water tanks are located on the roofs of buildings for fire purposes, etc., a convenient system should be adopted to prevent them from freezing in cold weather. Where I am employed there are three tanks on the roofs of three buildings. These tanks are used for emergency in case of fire. It is therefore necessary they should be in a condition to respond when called upon to perform their duty.

We have an automatic sprinkler system to which these tanks are piped as well as a high and low water electric alarm to communicate to the engine room showing which tank the alarm comes from, so we can start our fire pump to that particular tank or all three tanks, as the case may be.

As will be observed from the sketch, if the pump from *D* is on *A* only, valve *B* and *C* will be closed or all three may be open if it becomes necessary to pump in them all at the same time.

Now in regard to preventing them from freezing up in cold weather. A pipe for live steam was run down as at *E* and connected with the three horizontal steam pipes. We usually heat up one tank at a time. To heat the water in the tank from pipe *A* valves *F* and *H* on the live steam pipe are opened and the valve *G* is closed and the steam goes to tank through the pipe *A*. When the steam has been on this tank long enough the valve *H* is closed and valve *G* opened to drain any condensation that may remain in the pipe. I apply the same operation in heating the tanks from pipes *B* and *C*. The valve opposite *D* is to drain the pipes after pumping in the tanks so the lines *A, B* and *C* are virtually empty except when the water or steam is going into the tanks, as they run up the outside of the tanks and over the top into the tanks about 1 foot.

An overflow is attached to each tank near the top and one of the overflows froze last winter. About the same time the alarm got out of order and failed to ring until the water was above the overflow pipe. The overflow leads to the gutters on the roofs which were full of snow and ice. One warm afternoon the sun melted the ice in the overflow pipe and the gutter being frozen full, caused a deluge of water to come from the roof to the sidewalk.



PIPING SYSTEM TO WATER TANK.

Our foxy superintendent happened to be the first one to observe it, and with all haste he made for the engine room, trying to convince us that I had pumped the tank over. Not until the cause of the trouble was located would he believe otherwise.

A few words about the superintendent may not be out of place, as the general run of them causes no end of annoyance and uncalled-for interference with the engineer. In one place where I worked he was continually complaining about the fireman standing around too much, but in reality he had not much time to stand around because he had four boilers to look after.

However, on one of his vigilant rounds he caught

ireman doing nothing so he qrdered him out in
ard to assist the carpenter in pulling nails out of
old lumber and kept him pulling away until the
ıe pulled the steam down. The result was that the
were burned completely out and the place was
down for over an hour uñtil the ashes were hauled
ınd new fires built and the steam raised again.
fireman pulled no more nails and the superintend-
ost his position as the evidence was too strong
ıst him. Jas. G. Sheridan.

Outside Work.

ır of the Engineers' Review:
e letter by Exhaust, on page 23 of the February
, while short has a good deal in it, and emphasizes
oint I have always talked against ever since I be-
an engineer, and that is of a manufacturer com-
ıg his engineer to do outside work. The ex-
ıce of Exhaust while he was learning the busi-
is nothing out of the ordinary, and I feel safe
ying that more than 60 per cent of the engineers
.ting at the present time are compelled to go out-
:he engine and fire room and do the work which
d be done by others.
e idea of the man who has charge of an engine
ɔoiler, even though he is a beginner and not sup-
l to know much about the business, being obliged
ɪey the beck and call of some blacksmith to go
swing his 10-pound sledge and keep at it until
ıre is burnt down and it is necessary to suspend
smithing and go back to engineering! Then, ac-
ng to Exhaust's story, the foreman would send
:o the foundry, a mile or more away, for castings,
: the engine and boiler were left to the tender
ies of the blacksmith and his sledge.
.ere is nothing so very much out of the way in his
:ience, as has already been said, but it seems to
hat it is a point that cannot be dwelt upon too
ı or too often by engineers who care anything
t their plants or the duties which they have to
ırm. There are many men today who are draw-
alaries of from $2,000 to $10,000 per annum who
ɪaid, not so much for the actual amount of work
do, but for the executive ability which they have
because they know how a thing should be done
when it is done right. I fail to see why this will
.pply to the stationary engineer.
has been argued by a good many who have never
:he duties of an engineer to perform, that because
:ngineer's work in and around the engine room
not keep him busy 9¾ hours out of every 10
he can well afford to do extra work. The claim
t forth that an engineer, whose duties only occupy
or three hours each day in actual manual labor,
ld not be unwilling to give the rest of his time
s employer in some other part of the works doing
thing which is entirely foreign to steam engineer-
and that he has no right to expect to get paid for
ours work when he really is not busy more than
or three. This sounds all right from the manu-
ırer's point of view whose sole aim is to get as
ı work out of his employes as he possibly can, and
ı't know that any one objects to that, but when you
: to look at it from the engineer's standpoint you will find it the same as any other question, it has two sides.

If an engineer is employed by a manufacturer in a plant so small that he is also able to do his own firing, in the majority of cases it will be found that the remuneration for his labors is in a sense in a ratio compared with the duties which he performs. Therefore, the man who is running a small plant for $2 a day is doing just as much for his money, even though he sits in his chair eight hours out of ten, as the man who is getting $20 a week operating a plant of larger size and sitting down eight hours out of ten.

In my experience I have found that the man you find sitting down the greater part of the day is the one who fixes up things when he sees they need it. By doing this he can find time for leisure, while the man who is always neglecting things is always on the go. I have found that an engineer who goes to his plant in the morning and operates it successfully from day to day earns every cent that he is getting, even if he does sit down eight hours out of every ten. I cannot see why an engineer should not be paid for what he knows as well as members of any profession.

A doctor will make a professional visit, feel your pulse, make you stick out your tongue and roll your eyes around and then give you a paper which will cost anywhere from 50 cents to $1.50 to have filled at the drug store; and goes away after a visit of 5 minutes duration. When you come to pay your bill you find that you must pay him $1 to $2 and sometimes $2.50, all depending on what kind of a conscience the doctor has. They are not being paid for what they did, but for what they knew; why should not this same rule apply to engineers? If they are called to a plant to take charge of it and they find it in a fit condition, and keep it so, or find it in a run down condition and build it up, why should they be expected to do other work, or why should they not be paid for what they know, which knowledge enables them to keep the plant in its proper condition? I say it's up to every engineer to do all in his power to abolish this idea on the part of the steam user that he should earn his money by what he does rather than by what he knows. If an engineer doesn't know enough to demand some recognition for his knowledge, he surely does not know enough to have charge of a steam plant. F. S. Jenkins.

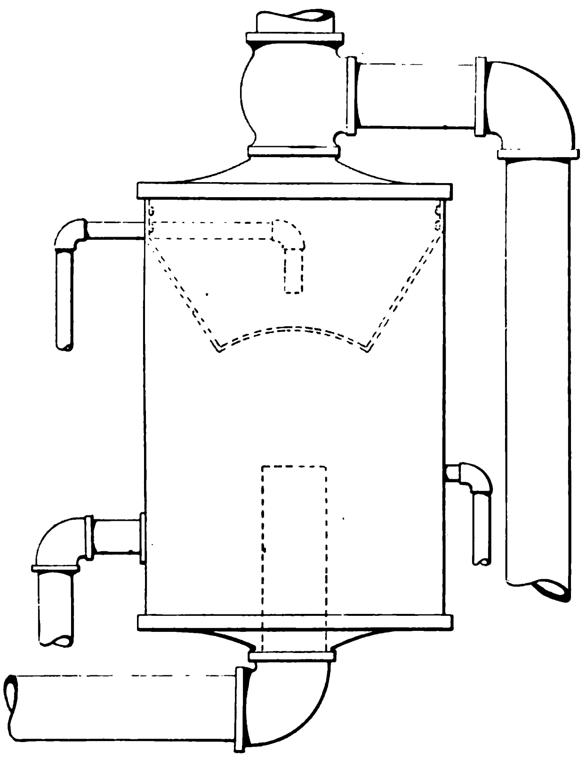
Open Heater Used With a Condenser.

Editor of the Engineers' Review:

A few months ago under "Engine Room Chats" Sam, in discussing with Mr. Winters, the advantages and disadvantages of the open and closed heaters, says that the open heater cannot be used with a condensing engine. I say that it can, for I know of an actual case in a plant that has as little trouble and is operated as economically, as any of them.

The heater I refer to may be used with or without a condenser, the exhaust pipe, where it leaves the heater being provided with a tee which leads a pipe to the atmosphere as well as to the condenser. The heater stands on its end and the exhaust pipe enters at the bottom and rises about 3 feet, as shown in the illustration. The water is forced in at the top of the heater by the atmospheric pressure, and in falling through the rising steam is heated, after which it rests in the chamber surrounding the exhaust pipe and deposits such particles of mud and scale as will be deposited at that temperature, which is about 165 degrees. The water runs off to the boiler feed pumps from a point about 1 foot from the bottom of the heater. Just below the end of the exhaust pipe, an overflow pipe leads off to the condenser, to prevent the water rising above the end of the exhaust pipe.

I agree with Sam in all else he says, but he was wrong when he said the open heater could not be used when running condensing. For my part, I do not see why the open heater is not more generally used. They are more efficient as feedwater heaters and purifiers, and the deposit of mud and scale to a reasonable extent does not lower their efficiency. From the discription given above it will be seen that, in this particular heater the oil will be carried off through the overflow to the condenser. Motor.



OPEN HEATER AND CONNECTIONS.

Details.

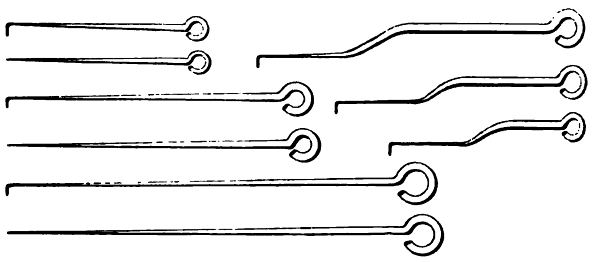
Editor of the Engineers' Review:

While reading over the January issue I came to the letter by Wm. E. Ryan, showing an indicator card and as he would like to have the opinion of the readers as to what was wrong with his engine I will hazard a guess. I think his engine is all right, but his card doesn't show it. It is quite evident that the card was not taken in the ordinary way, but I should say that the indicator cord had been attached to the eccentric movement in some manner. Such a procedure would, in my opinion, bring about results as shown in his card.

In reading the letter by G. M. B. on page 35 it does not seem to me that his method of tightening an engine disk would amount to much.

When one thinks of the strain that is put upon a crankshaft it seems hardly possible that a few center punch marks will expand the shaft enough to prevent the disk from working loose, as the shaft is only expanded on the end and causes the outside face of the disk to fit tight, while the inside would fit as loose as it formerly did. I should judge in such a case that the proper procedure would be to have a new crank disk shrunk on the shaft. Certainly his method would not apply to engines of any great size, although it might with very small ones.

The letter by I. Mulford on page 13 is one worthy of attention especially the portion referring to the feedwater thermometer. It is doubtful if one-half of the engineers realize the benefit and saving that can be obtained by means of the feedwater thermometer. Of course the thermometer itself is simply a telltale as to the temperature of the feedwater as it leaves the heater on its way to the boilers. The advantage of having a feedwater thermometer is that an engineer always knows the temperature at which the water is going into the boilers. If he is fortunate enough to have a heater that will bring the temperature of the water up to 210 degrees and upon examining the thermometer finds the temperature is down to 200 or even 190 degrees F., he is at once aware of the fact that the heater is not working as economically as it should and that a loss is occasioned by the feedwater entering the boilers at a lower temperature than it should. By this means, if the engineer is at all careful in regard to the operation of his plant, an investigation will follow and the reason the heater is not bringing the temperature of the feedwater up as high as it should be is ascertained.



PACKING TOOLS.

A mistake is often made by the engineer in regard to these little things, and many times losses are going on day after day which never come to his attention, simply because he has no way of finding where the leaks are. In the case of a feedwater thermometer it is only the expenditure of a few dollars and a little time in putting the thermometer in place, which in the end will pay for itself more than ten times over.

The pipe bending device is also a handy little machine to have, because it, too, has its place in the economical operation of the plant, as every elbow and connection done away with reduces the friction of whatever is passing through the pipe, and friction costs money, wherever it is found.

I was much interested also in the letter by W. E. on page 16, relative to his packing sticks. This has

iced me to show some of the packing tools that
e in my plant, some of which are common enough
one or two of which are designed for special use.
y are shown in the illustration.
like his way of putting packing into a stuffingbox.
y engineers are in the habit of putting the ring
cing around the piston rod or valve stems and then
ing it home with a metal packing tool. Quite
n the tool slips off and scratches or dents the rod.
some years back I have made use of packing sticks
lar to those shown in his letter and have never
afraid of injuring the rods in any way.
his brings up a subject which is of interest to en-
ers as a whole and that is the matter of having
dimensions of nuts, bolt heads, stuffingboxes,
ds and all such things of uniform size. If this
the case we would not find a certain size
acking fitting one rod and stuffingbox as it should,
next loose and another one so tight that the pack-
has to be driven in. The latter case is where the
cing sticks come in handy. L. M. Wentzel.

Card Index.

tor of the Engineers' Review:
he fact of your publishing an index of the con-
s of the Engineers' Review for the past year has
gested this letter on card indexing. Much of the
t valuable literature of the engineering profession
y is found in the engineering magazines. It
mpossible for a man to remember everything
ch is published relating to subjects which are
nterest in his work. The thing to do is to read
preserve what one reads. To obtain knowledge
porarily and then not have that knowledge avail-
when desired is of little benefit to any one because
ittle of what is read is really retained in the mind.
good engineering paper should be the chum of
y engineer and always ready at hand when mo-
ts of leisure permit of its perusal for instruc-
and enjoyment, but as already said all that
ritten cannot be retained in the mind and it is of
ortance that engineers should know where to find
ter on the various subjects that have appeared in
ineering journals that they have read.
he card index will obviate the difficulty and give
ly access to what has been read by recording the
rmation in the form best adapted to the needs
erned by his own peculiar habits of mind and mem-
The card index is really a written memory of
ything which may come in handy. The features
he card are as follows: They should be made of
te linen ledger paper and very tough. Many make
mistake of having the cards too thick, as they are
flexible and are too bulky, while on the other hand
ry thin card is not durable and works up out of
e unless something is used to keep it down. A
l 3 x 5 makes a very convenient size and can
ought for about 60 cents a thousand. Guide cards
needed for the alphabet and should be thicker and
her than the others because of greater handling.
cards should be kept in a paste board envelope
or if the engineer chooses, he can have a box made
ome kind of wood. The making of a card index
growth and the easiest way to get started is to
l the papers, having plenty of paper slips at hand. When an article of importance is read, place at the top of the card the subject of the article, not necessarily by the title with which it is designated in the paper, but under the subject which appeals to the mind after reading and it is well to say right here that this is the most difficult part of card indexing because one is very apt to use an adjective as the main word in the index rather than the noun. A perusal of the index of some of the up-to-date publications will give a general idea of how this may be done. Often it is quite an undertaking to index a piece of information, but in a case of this sort it is well to remember that everything has two parts, the thing itself and the function for which it is employed. When the thing is the more important the article should be indexed under the thing, but if the function is the more important, then index under the function. It is well to "cross index," as it is called, *i. e.*, have two or more cards which index the same subject, under different heads and having a note on each referring back to the main card, giving the subject. A liberal use of the cross index is an excellent thing because one's mind does not always work on the same lines and important data can often be varied, even with a card index and three or four years later one may not be able to recall just the heading under which a certain article was indexed, but he is sure to remember one out of the several headings under which it might be indexed if the cross index were used. After the subject should come the name of the paper with the year and the page, after which a short description of the article with an opinion as to its value or application should be written upon the card. When the card is made out it should be filed away in proper alphabetical order as soon as it is made up, allowing no accumulation of cards, for they soon become clogs and cause disorder.

The card index has the following advantages: One is always able to get at it and nothing is buried or lost. It saves time for the man who is after information and it can be enlarged from time to time and still be good; new material can be inserted in the proper place without disturbing anything else and it can be made to suit every frame of mind and every sort of business. Nothing has to be written and it can be operated by any one, and when a thing becomes worthless or outgrown there is no need of retaining it and it can be destroyed. It has the advantage of being always up to date and easy to rearrange.

Harry Teeman.

By the bursting of the throttle valve in the engine room of the Ontario Sewer Pipe Mfg. Co. at Mimico, Canada, the engineer was so severely scalded that his recovery is extremely doubtful. The piping system was carrying a pressure of 95 pounds. The engineer was standing at the throttle when the accident occurred. The most probable cause is water hammer.

Investigations made in Germany have convinced some eminent authorities that the strength of steel is so much affected by heat that tests of steel for boilers and pipes ought to be made when the metal is as hot as it is likely ever to become when in use.

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FUEL ECONOMY.

The question of fuel economy is one that has received in some quarters considerable attention, but in others it has not. It has received attention from various authors who have given expression to some valuable ideas and suggestions, but the operating engineer has not yet awakened to its importance.

The engineer who takes an interest in the subject does not enter into it in its entirety. Perhaps this is because there are so many different phases of the question that the engineer gets discouraged before his investigation covers it.

There are many points to consider and experiment upon before the question of fuel economy can be settled to the satisfaction of anyone who is carrying on a thorough investigation.

In the burning of fuel in an economical manner the subject can be approached from the standpoint of combustion, heat transmission and steam generation. These three heads can be divided and sub-divided. In fuel economy measures must be taken to control the coal and water supply, the combustion of the fuel and the testing of the waste gases. In the economical combustion of coal sufficient air, but not an excess, must be provided, also a sufficiently high temperature in the furnace, and a perfect mixture of the gases and the volatile hydrocarbons secured. If these conditions are filled, bituminous coal can be burned under steam boilers with the highest efficiency and without the production of smoke.

Other points to consider are form of grate, manner of lining the furnace with fire brick, and the boiler setting. Other heads for experiment are the influence of the output and load factor of the plant, the management of the fireman, the economy of different types of mechanical stokers, if any, and under what conditions one type may be operated with better economy than others, also how mechanical and hand firing compare as to economy. Forced draft also has considerable to do with the economical operation of the steam plant as well as in the first cost of the plant. The analysis of the fuel determines to a great extent what sort is the least costly, results considered, and is therefore necessary to economic management.

Among other ideas already being worked upon is that of introducing hot air into the ashpit, which is inclosed, and operating it in conjunction with forced draft; by this means a much higher temperature can be obtained in the furnace.

NECESSITY OF VIGILANCE.

Many of our readers who have noticed the numerous boiler accidents recorded in the Review during the last six months, have doubtless read the items with little or no thought as to the real causes of the accidents, treating the matter as a natural course of events — something to be expected so long as steam boilers are operated at the pressures now carried.

We admit that there will be more or less boiler explosions as long as high pressures are carried, but we do believe that there would be fewer if the men in charge were as vigilant as they should be, in caring for their boilers. We will go farther and say that there is little doubt but that three-fourths of the accidents to boilers are brought about by carelessness, neglect, or abuse. Ignorance is also responsible for many explosions.

We do not think that the majority of steam plants are free from all of the above mentioned evils and if every engineer throughout the country would tell of the cases which have occurred in his own experience where neglect or carelessness, let alone ignorance, has been the cause of trouble, in the boiler room, and in other departments of the steam plant, it would be interesting and perhaps startling. It is because the narrow escapes are never known that so many engineers continue to tread the path of carelessness and neglect. Each man's experience should be a warning to him even though he keeps it locked in his own breast. If there were any way of definitely learning the cause of the majority of boiler explosions and other accidents around the power plant many engineers, if not all, would be scared into vigilance.

If men knew how often vigilance has prevented accidents and saved lives the lesson would not be lost.

Vigilance is especially required of men around a steam plant and successful engineers do not lack it.

The vigilant engineer is not in the habit of stopping his engine to repair something during working hours, thus costing his employer the time the other employes are idle. It is not necessary. He notices the things that are getting out of order, and taking time by the forelock, repairs them before a shut down is necessary.

The vigilant engineer will not hesitate to stay an hour after the others have gone home, if by so doing he can prevent an accident, or avoid stopping the power during work hours.

We have in mind a plant where the power was stopped eight times in one day recently, because the power department was not in a condition to operate. This plant consists of nine boilers and four Corliss engines and is not located in a saw mill by any means, but in the heart of a large city. The following day the power was stopped twice for some reason or other.

While there are many difficulties to overcome in this plant, in order to get it into proper running order, the main reason for its being in such a condition is that the engineer neglected to have certain necessary work done when it should have been done. In this case vigilance and promptness would have helped matters in a wonderful way. It will do the same thing for any plant and the engineer who learns early in life to be vigilant and prompt is the one who will be pointed to as time passes, as the man who seems to have been born under a lucky star, a man whom luck seems to favor. Those who envy him overlook the fact that his good fortune is due to himself.

BOILER TUBE CLEANERS.

Two articles recently published in engineering papers have raised the question of possible injury to boilers by the use of power tube cleaners. One, taking up the matter from the so-called theoretical standpoint, discusses the possible action of cleaners when improperly used, while the other gave results found by some of the inspectors of a well-known boiler insurance company in boilers in which such tube cleaners had been used. Both call attention to possible sources of danger, and the question arises whether there is as much danger as alleged or whether there was over-drawing and exaggeration.

It is quite true that any tube cleaner which distorts a tube beyond its elastic limit is injurious, but on the other hand it is doubtful if any of the reliable tube cleaners now on the market, when used by men of ordinary intelligence and care, such as must be exercised in handling any tool used around a power plant, will work injury to boiler tubes. The point is brought out, referring to such devices as those having a swinging hammer, that if the shell of the cleaner is smaller than the tube, while resting upon the bottom of the tube the downward blow of the hammer will be heavier than the upward. From elementary physics we know that the factors upon which the force of the hammer blow depend are the weight of the hammer, its velocity, the space through which it moves, and the surface of the material which the hammer strikes. The upward blow from such a type of cleaner would apparently be the heavier because with a constant force acting, the longer the blow of the hammer the greater the force of the blow, so that if the upward blow has the longer stroke, it should be heavier. This is directly contrary to the argument brought out in one of the papers alluded to. On the other hand, supposing the stroke to be gradually shortened so that the hammer barely moves from its central position, it is evident that under such a circumstance, the force of the blow will be very much lessened.

The insurance company's article cites cases of boiler tubes being expanded, changed into oval shapes, and in some instances even split. This is not, as they claim, proof that these deformities were brought about by the use of boiler tube cleaners. The suggestion is pertinent that the weaknesses shown in the tubes were brought to light only by the use of the tube cleaners, the defect having existed before, but without the engineer's knowledge until the application of the tube cleaner.

It has been stated that the vibration caused by tube cleaners is injurious, inasmuch as it tends to loosen the tubes in the tube sheet. Prof. Kavanaugh, of the University of Minnesota, states that the maximum blow struck by the largest size cleaner in a 4-inch tube with a steam pressure of about 90 pounds gave a blow of .151 footpounds, and that the number of blows per minute was 4,530.

Prof. Kavanaugh says: "I find that the vibration of a flue produced by the cleaner is not a vibration from end to end like the vibration of a string of a musical instrument, but rather a 'broken up' vibration or tremor extending from header to header. However, the tremor for a distance of about 8 inches from the header is very slight, in fact it can scarcely be detected."

He also stated that in his opinion the tremor is not sufficient to loosen a well rolled tube at the head, and that there is no question that a cleaner will bring to light any weak spots which exist in boiler tubes. In this he only corroborates experience, from which we are forced to the conclusion that the use of boiler tube cleaners is to be commended not only for their value in removing scale from tubes, but in showing defects which would otherwise remain unnoticed, jeopardizing life and property. There is no doubt, however, that by the careless use of tube cleaners great injury may be done to boiler tubes. An engineer should bear in mind that their misuse is abuse, as is the case with any other appliance or apparatus around a steam plant.

This brings to mind the discussions pro and con regarding the use of boiler compounds and mechanical boiler tube cleaners. There is no doubt that each has its merits and has given evidence of its usefulness or it could not continue to exist.

Good judgment and care should be exercised in the use of mechanical cleaners and as much if not more intelligence is required where boiler compounds are used.

QUESTIONS
·OF THE HOUR·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.
The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

---

(404) K. R., Litchfield, Ill. Q.—"I would like to know if boiled water will freeze quicker than unboiled water?" A.—It is the generally accepted theory that boiled water freezes more quickly than unboiled water, due to the fact that boiling drives out much of the air and carbonic gas.

(405) O. C. B., Lawton, Mich. Q.—"I have a down feed lubricator which fills up and I cannot tell anything about how it is feeding. What is the trouble?" A.—There are several reasons why a lubricator may fail to operate properly, such as leaky joints, foreign matter getting into the feed valves, or into the discharge passages. The packing at the top of the glass may have become squeezed over so as to prevent the passage of the oil. Probably the most common cause of lubricators not feeding as they should, is because the condensing pipe is not long enough to allow of enough water of condensation to displace the oil and force it out of the lubricator. The remedy in such a case is to lengthen the condensing pipe.

(406) B. C. S., Hampton, Iowa. Q.—"Is there any soldering flux that is used to solder aluminum, and if so, how is it done?" A.—Aluminum may be soldered in the following way: Clean off all dirt and grease from the surface of the metal with a little benzine, and apply the solder with a copper and when the molten solder is covering the metal, scratch through the solder with a wire brush. In this way the oxide on the surface of the metal underneath the solder is broken up and the solder, which contains its own flux, takes up the oxide and so the surface of the metal is tinned. Very quick work must be done while attempting to solder.

(407) B. McD., North Adams, Mass. Q.—"I have just been up against the inspector and I would like to know if a difference is made in the steam distribution when the point of cutoff is changed and when the throw of the eccentric is changed?" A.—Yes, there is a difference. Altering the angle of advance of the eccentric changes the events of each stroke; changing the throw of the eccentric increases or decreases the valve travel and affects the port opening as well as the events of the stroke.

(408) F. P. K., Saxonville, Mass. Q.—"Will you kindly tell me how to find the ratio of expansion in my engine cylinder? Please give it so it can be worked out mathematically." A.—In computing the nominal expansion ratio which is the proportion between the full stroke of the piston and that portion of the stroke during which the steam is not cut off no clearance or waste places between the piston and the cylinder head at the end of the stroke are taken into account. If the stroke of the engine is 36 inches and the steam is cut-off at 1-6-stroke or 6 inches, the expansion ratio will be $36 \div 6 = 6$. If the clearance in the end of the cylinder is, say ½-inch, between the piston and the cylinde head at the end of the stroke, we have ratio=(36+.5 ÷(6+.5)=5.46. This is the actual expansion ratio as it takes into account the influence of the clearance i the cylinder.

(409) J. H. B., Clay City, Ky. Q.—"Please giv the rule for figuring the horsepower of locomotiv engines." A.—To find the horsepower developed b a locomotive the following method is employed: Multiply the piston area in square inches by the mean effective pressure, and the product by 2, there being tw cylinders. This is the power transmitted by both cylinders. This result is multiplied by the piston speed i feet per each revolution and the product multiplied b the number of revolutions per minute; this divided b 33,000 equals the horsepower.

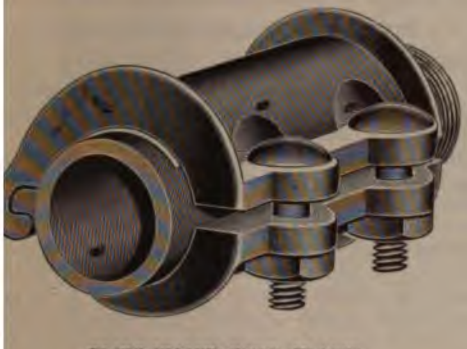
(410) J. C. L., Boston, Mass. Q.—"Will yo explain the method of making an analysis of boiler flu gases, using the Orsatt apparatus, also the names an proportion of chemicals used?" A.—We have no the space to devote to a full explanation of the abov mentioned process at this time, but will do so later on You will be able to obtain the desired information b referring to the paper by R. S. Hale on "Flue Ga Analysis," published in the Transactions of the "American Society of Mechanical Engineers," Vol. XVIII page 109. You will doubtless be able to obtain thi volume in the Boston public library.

(411) G. C., Spring City, Pa. Q.—"What is th horsepower of a common slide valve engine cuttin off at half stroke? The cylinder is 14¼x20-inch, running at 120 revolutions a minute." A.—The area o the piston is $14.25 \times 14.25 \times .7854 = 159.48$ square inches The piston speed is $20 \times 2 \times 120 \div 12 = 400$ feet. 159.4 ×400=63,792. As you do not give any mean effective pressure we will assume that there are 35 pounds which is probably enough for an engine cutting of at half stroke. Therefore we have 63,792×35=223, 272. $223{,}272 \div 33{,}000 = 67.6$ horsepower. The abov calculations are made from an assumed mean effectiv force. The only correct way of getting it is by mean of an indicator diagram. If the engine is of the singl valve type it would do better work by cutting off a about ¾ stroke.

(412) G. C. B., Paris, Mo. Q.—"What is the bes method of driving up a small bag in a boiler shell The bag is directly over the furnace and is abou 6x2x1½ inches in dimension. Is it necessary to bor a hole in the center of the bag, and if so what is th best method of stopping up the hole after the bag i in place?" A.—Bags can be forced up with an without drilling a hole in them. When the bag i small there is no necessity for drilling a hole, bu when it is of large proportions a hole may be drilled in order that the metal may have a place to fill up This is because the metal can never be brought bac to its original condition again. In our opinion if bag is of such proportions as to necessitate the drillin of a hole in order to force it back in place, it ha better be cut out and the plate patched. With a ba of the proportions mentioned, we would advise cuttin it out and patching as it is extremely doubtful if i could be forced up in place. Such a bag is ver unusual. With a patch there is no danger of its giving way, as was the case of the bag illustrated in th February issue.

EMERGENCY PIPE CLAMP.

and simple pipe clamp has just been brought ames McCrea & Co., 67 W. Washington street, Ill., and is shown in the accompanying illus- The clamp is made of malleable iron complete king ready to use. It is made in two sections,

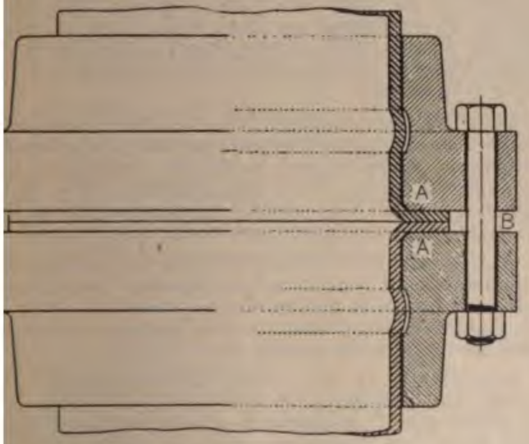


EMERGENCY PIPE CLAMP.

n one side and clamped together by two bolts ther. It can be attached in a moment and by ication, will in many instances save loss of due to spraying water or steam, beside the time while making immediate repairs. For pair work of pitted holes, splits, or other leaks nature, this clamp should find considerable ith engineers. The clamps are made in sizes es from ½-inch to 4-inches in diameter.

X ROLLED AND CORRUGATED PIPE JOINT.

ype of pipe joint is made for the high pressure nes which are of necessity demanded in the of the modern steam plant. The Climax pipe adapted to high pressures because the pipe



X ROLLED AND CORRUGATED PIPE JOINT.

ipe to pipe and cannot leak between the pipe ge. The joints are not affected by expansion raction, as in the case with flanges and pipes solid. There is no threading, and conse- o weakening of the pipe; no screwing, shrink- xpanding, thus bringing no undue strain on the flanges. Neither is there any peening which tends to crystallize the pipe or rivets to invite leaks.

The Climax flanges swivel, which is quite an advantage in the erection of a pipe line. It serves to take part of the strain off the pipe as at *A*, in the illustration, and by driving a chisel between the flange *B*, to force the joint apart when necessary, the gasket face is not affected. It also insures the flanges coming together square, thus removing the danger of cast iron flanges breaking when bolting them together. Another thing, in using this joint, is that a higher grade of piping must be used in the pipe line construction, as ordinary pipe will not permit of turning over without splitting.

The Climax joint is made in cast, gun and malleable iron, semi, cast and rolled steel. It is no experiment, and has been in use for years and has been found satisfactory. It is manufactured by the Best Mfg. Co., Pittsburg, Pa.

WRIGHT CYCLONE EXHAUST HEAD.

We illustrate herewith the construction of the Wright Cyclone exhaust head, which is manufactured by the Wright Mfg. Co., 82 Woodbridge street, Detroit, Mich. Its operation is plainly shown by the sectional view from which it will be seen that the exhaust steam, after leaving the exhaust pipe, is impinged against an inverted cone and is then deflected outward against the sides of the inner shell, where the oil and condensation adhere and drip into the gutter, to be carried below the flow of steam by the drip pipes.

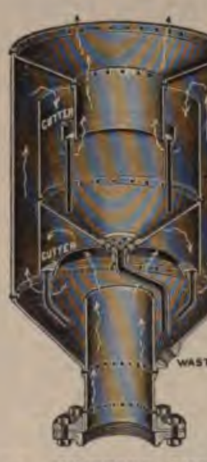


FIG. 1. INTERIOR VIEW OF HEAD.

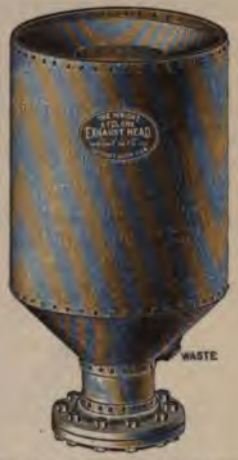


FIG. 2. EXTERIOR VIEW.

The steam after being deflected by the cone, passes up between the outer and inner shells (follow the course of the arrows shown in Fig. 1), and is again impinged against another inverted cone forming the top. The steam then turns and passes down between the inner shell and the outlet pipe, the remaining condensation being removed from the steam by its contact with the under side of the top cone and the outlet pipe. This condensation is then collected by means of the gutter surrounding the outlet pipe and the five drip pipes lead it below the flow of steam to the waste pipe.

In the construction of the Cyclone a fault common to many exhaust heads is said to be entirely avoided;

i. e., the possibility of back pressure being caused upon the engine. Reference to the illustration will show an entire absence of cramped passages, and the outlet is also several times larger in area than the inlet, both of which advantages tend to give a free, easy flow of steam.

The construction of the Cyclone exhaust head is high-grade throughout. Built for service, not merely to sell, is the manufacturers' claim.

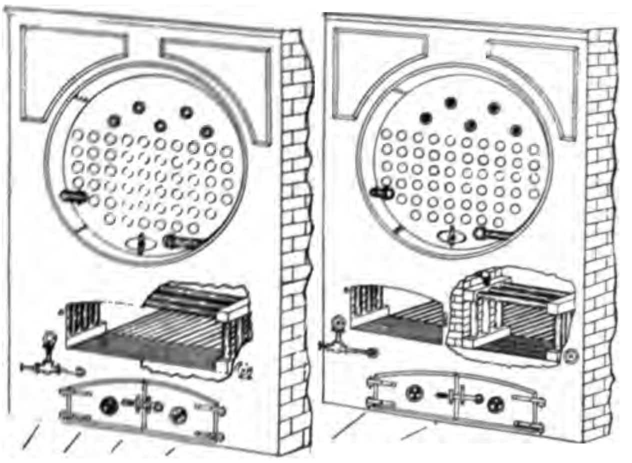
Extra heavy galvanized plate is employed throughout the construction of the Cyclone exhaust head. The drip pipes from the gutters and cone are of galvanized iron and the connections being made of brass, prevent rusting at points where repairs would be impossible. The waste flange is also heavy brass, and is strongly riveted and soldered to the shell. A heavy coating of rust-proof paint protects all exposed parts. Fig. 2 shows an exterior view.

Further particulars as to the extremely durable construction of the Cyclone exhaust head, its efficiency under all conditions in extracting moisture and oil from the exhaust steam, also muffling the noise of the exhaust, will be furnished by the Wright Mfg. Co., who are also manufacturers of the well-known Wright emergency high pressure and Victor low pressure steam traps, and the Wright improved safety water column.

LAMPREY PROTECTIVE ARCH PLATE.

The Lamprey protective arch plates for boiler furnace mouths are for the protection of the fronts of boilers against the intense heat which reflects against the brickwork, causing the continual burning out of the plates on the inside of the furnace doors and the cracking of the fronts.

The device consists of pipes running along the side and top of the furnace openings as shown in Figs. 1 and 2, being at all times filled with water from the boiler or pumps, which in passing to the boiler causes a rapid circulation at all times, while the boiler is being fired. By this method the heat is absorbed and ultilized in the generation of steam or in the heating of the feedwater, thus making a great saving in fuel and avoiding the expense of repairing brickwork or cast-iron arches and cheek pieces every few months. One engineer claims an average gain of from 80 to 85 degrees heat in the temperature of the feedwater. This device is manufactured by the Lamprey Co., Westfield, Mass., who will be glad to furnish any further information.



FIGS. 1 AND 2. LAMPREY PROTECTIVE ARCH IN POSITION.

NEW BOOKS AND CATALOGS.

AUTOMATIC SURVEYING INSTRUMENTS and their practical use on land and water, by Thos. Fergurson. John Ball, Sons & Danielsson, Ltd., Oxford House, 83-89 Great Titchfield street, Oxford street, W. 1904, 87 pages, 7x4¾, 26 illustrations, cloth, 96 cents. This is an interesting volume for those interested in automatic surveying instruments. The introduction is by Professor Dr. E. Hammer, Ph. D. The first chapter treats on the pedograph, an automatic rout tracer for pedestrians; treating on the underlying principles of the instrument, its constructing and working conditions governing its accuracy, its disadvantages, the amount of practice required to handle it and detailed directions for handling it. Chapter 2 treats on the Cyclograph, an automatic rout tracer for vehicles. The construction and working is explained, also the details for use. In chapter 3 the Hodograph, for self-registering of courses and distances on water. Reasons are given as to the planning of the Hodograph, its functions, construction and working. The chapter also takes the adjusting scale, neutralizing tides and currents, also its place in the vessel, kind of vessel used and actual results obtained. The book gives a very comprehensive idea as to how these instruments operate.

"STEAM TURBINES," by Dr. A. Stodola. D. Van Nostrand Co., New York. 434 pages, 6 x 9, cloth, 241 illustrations, three lithograph tables, $4.50 net. This volume consists of a series of important constructive details which are but little known and therefore form a valuable reference work on steam turbine construction. The volume is the result of a scientific investigation and the result of many experiments, which have been presented in as reliable form as it is possible. Dr. Stodola is considered the standard authority on the subject of steam turbines in Europe, and this volume is a translation of the second edition of his work. There are other works on the steam turbine written in the English, but none in which the subject is so exhaustively treated from a purely scientific standpoint. Among the prominent heads treated are the elementary theory of the steam turbine, the theory of the steam turbine thermodynamically considered, and the construction of the most important turbine. Then the different types of steam turbine are dealt with, 19 in all, also special problems of the steam turbine theory and construction. The volume also has an appendix on gas turbines and the future of the heat engine.

"PUMPING MACHINERY AT ST. LOUIS" is the title of a handsome and interesting book illustrating and describing the pumping and condensing machinery at the St. Louis World's Fair. This and pamphlet WEV will interest engineers, and can be obtained by addressing Henry R. Worthington, 114 Liberty street, New York.

COLUMBUS PIPE THREADING and cutting machinery, manufactured by the Columbus Machine Co., Columbus, O., is described in a pamphlet recently received. This company also manufacture gas and gasoline engines for all purposes. When writing ask for catalog 26.

"ECONOMICAL GAS AND OIL ENGINES" is the title of a handsome folder descriptive of the Koerting gas engine. The folder also illustrates several of the different types of the above engine. It is manufactured by the De La Vergne Machine Co., foot of East 138th street, New York.

THE L. S. STARRETT CO., Athol, Mass., manufacturers of high grade tools for engineers, machinists, etc., have issued a handsome catalog of about 175 pages. It would take considerable space to enumerate the different articles they manufacture, so we advise interested parties to write for this catalog, which is No. 17, and mention the Engineers' Review.

A BOOKLET ENTITLED "Pipe and Boiler Coverings and Their Uses" is being distributed by the H. W. Johns-Manville Co., 100 William street, New York.

HE SWIFT LUBRICATOR CO., Elmira, N. Y., manu- urers of sight feed lubricators and steam brass goods, e sent us a copy of their latest catalog. Many of our lers are not familiar with this company's products, and should be.

AUM SEPARATORS for live and exhaust steam are de- bed and illustrated in a handsome 25-page catalog that been handed us. Baum separators are manufactured by Baum Separator and Machine Co., Manheim, Pa.

E HAVE RECEIVED the catalog and price list of dstrom's Corliss valve steam trap. There are several fea- s about this trap that will interest engineers. It is man- ctured by John T. Lindstrom, Allentown, Pa.

NEW MONKEY WRENCH has been placed on the ket by the Trimont Mfg. Co., Roxbury, Mass., manufac- rs of wrenches for all purposes. The new wrench is de- bed and illustrated in a leaflet that is being distributed. ossesses new features that make it particularly valuable to users of monkey wrenches.

BUNDY STEAM TRAPS" is the title of a handsome log issued by the A. A. Griffing Iron Co., 475 Communi- avenue, Jersey City, N. J. This catalog is well illustrated interesting. By means of line drawings the application of dy traps for different purposes is shown. When writing n mention this publication.

NE OF THE LARGEST catalogs that has come to our e for some time is No. 39 issued by F. E. Myers & Bro., land, O. While the business of this company is devoted cipally to the manufacture of farming tools and pumps, have a good business in power pumps, working heads, p jacks, etc. The Myers Bulldozer pump is well known, the catalog illustrates and describes the working parts in ery satisfactory manner.

ARREN WEBSTER & CO., Camden, N. J., have pub- ed in pamphlet form a paper entitled "Circulation of Steam Heating Purposes at or below the Pressure of the At- phere." This paper was read, by request, before the So- y of Heating and Ventilating Engineers, by Reginald ham Bolton, C. E. and M. E. A copy can undoubtedly be ined by addressing the above company.

METROPOLITAN INJECTORS" is the title of a book- listributed by the manufacturers, the Hayden & Derby Mfg. 85, 87, 89 Liberty street, New York. This company make ral types of injectors and ejectors, and will be pleased to any further information desired.

WYCKOFF & SON CO., Elmira, N. Y., have issued a klet devoted to their steam pipe covering. This covering lifferent from the majority of pipe coverings, both in con- ction and materials used, and will doubtless be of much rest to our readers.

URRAY'S STEAM SPECIALTIES, which are manu- ured by the Murray Automatic Boiler Feed Co., 882 Scot- avenue, Detroit, Mich., are described in a catalog recently ived. Among the specialties they manufacture are the rray automatic boiler feed regulator, automatic pump gov- or, high pressure steam trap, etc., etc.

HANDSOME CATALOG devoted to steam boilers has sent us by the Brownell Co., Dayton, O. They make ral different types of boilers and engines, feedwater ters, boiler fronts, etc. Their catalogs will be sent to all write them mentioning this paper.

ATALOG A, which contains nearly 200 pages, has been us by the Williamsport Clutch and Pulley Co., Williams- , Pa. This company manufacture conveying, elevating and er transmission machinery. They also handle vertical and izontal engines, grate bars, etc.

THE DIESEL ENGINE" is the title of a catalog sent by the American Diesel Engine Co., 11 Broadway, New k. This engine is a fuel oil engine and made quite a wing at the St. Louis Exhibition. Its economy in opera- was of much interest to the engineering world. Further rmation can be obtained from the manufacturers.

DE LAVAL CENTRIFUGAL PUMPS" is the title of latest catalog issued by the De Laval Steam Turbine Co., nton, N. J. It is a very handsome one, well illustrated printed, and contains 50 pages. The company make steam ines for adaptation to nearly any kind of service where m as a power generator is required. No engineer calling self up-to-date can afford to neglect to familiarize himself this machine.

THE WESTERN ELECTRIC CO., Chicago, have sent us three of their bulletins, Nos. 3015, 3040-B and 3050, which are devoted to their type N encased and semiencased motors and generators, type G, open type motors and generators and motor-driven grinders, respectively. These bulletins will be sent to any engineer upon request.

THE OSTER MFG. CO., Cleveland, O., have issued a handsome catalog on their tools and machinery for threading pipe and bolts. They will be glad to correspond with any one in need of such machines.

A NEW METALLIC packing for which great claims are made has been patented and is being marketed by the Rhodes Bros. Mfg. Co., 2435 South Broadway, St. Louis, Mo. Engineers interested can obtain a copy of their catalog by addressing Rhodes Bros. at above address.

A VERY HANDSOME and interesting book is the one published by the Crocker-Wheeler Co., Ampere, N. J., for distribution at the World's Fair. It is known as Bulletin 47, and is a description of the Intramural Railway of the Louisiana Purchase Exposition.

THE JUST MECHANICAL system for cleaning steam boilers is fully described in a 30-page catalog issued by the Just Mfg. Co., 1215 Filbert street, Philadelphia, Pa. It is an old but always interesting subject to engineers.

THE ST. LOUIS CORLISS engine, manufactured by the St. Louis Iron & Machine Works, St. Louis, Mo., is described in a catalog handed us.

THE A. W. HARRIS OIL CO., Providence, R. I., manufacturers of all kinds of lubricants, have sent us a booklet entitled "Special Petroleum Lubricants." This booklet will probably prove of interest to many of our readers.

LEFFEL STEAM ENGINES AND BOILERS are described in catalog M which has been recently sent us by the Jas. Leffel & Co., Springfield, Ohio. The engines manufactured by this concern are all of small size, ranging from 6 horsepower to 50 horsepower. This company also make portable and semi-portable outfits for nearly all purposes.

THE THOMPSON damper and pressure regulator, which is manufactured by Richard Thompson & Co., 127 Liberty street, New York, is satisfactorily described and illustrated in a 20-page catalog which has been sent us. This catalog also contains about 6 pages of testimonial letters, all of which go to show that the Thompson regulator is a useful machine.

THE LANE & BODLEY CO., Cincinnati, Ohio, have been manufacturing engines for 50 years. Their newest engine is called the 20th Century Heavy Duty Corliss engine. One of these engines was installed in Machinery Hall at the St. Louis World's Fair, to operate the intramural railway. Any one about to purchase an engine for any purpose whatever should first acquaint themselves with the machines that are turned out by the Lane & Bodley Co. Their catalogs are freely sent to all who are interested.

A LARGE AND USEFUL CATALOG is one gotten out by the Jeffrey Mfg. Co., Columbus, Ohio, manufacturers of elevating, conveying, and power transmission machinery of every kind imaginable. This catalog, which is 72A, will be sent to all who are genuinely interested in this apparatus.

THE LATEST CATALOG on Goodsell packings has recently been received. These packings comprise nearly every kind in use by engineers and are manufactured by the Goodsell Packing Co., 27 So. Canal street, Chicago, Ill., who will be pleased to send their catalog.

THE ROBBINS & MYERS CO., Springfield, Ohio, manufacturers of desk and bracket fans, ceiling fans, fan motors and motors and generators of all sizes and types and other electrical machinery, have sent us their catalog. They are getting out a new catalog, but any one desiring information would do well to get a copy of the old one.

"DIXON'S GRAPHITE CUP GREASES" is the title of a brochure sent us a short time ago by the Jos. Dixon Crucible Mfg. Co., Jersey City, N. J.

THE RIDGE TRAP, which is manufactured by the Egdir Equipment Co., Carbondale, Pa., is briefly described in a folder recently received. This company also manufacture the Ridge separator, horizontal and vertical types, which is described in the booklet that they are distributing.

ELECTRICAL SUPPLIES manufactured by the H. W. Johns-Manville Co., 101 William street, New York, receive attention in a 100-page catalog recently sent us. Inasmuch as their line is very complete, it would be impractical to mention the different articles they manufacture, and the best way to do is to send for a copy of this catalog.

TRADE NOTES.

THE CHICAGO BELTING CO., of 69 South Canal street, Chicago, Ill., recently secured the order and furnished one of their 78-inch 3-ply Reliance belts to the Sleepy Eye Milling Co., of Sleepy Eye, Minn.

MANY COMPLIMENTARY LETTERS have been received by the Warren Co., 27 E. Chicago avenue, Chicago, Ill., from engineers and others who have used the Warren pulley cover. Jos. Domaas, superintendent of the electric light and water works, Fosston, Minn., writes: "I have used different kinds of belt dressings to no advantage. I think Warren's pulley cover is the best in the long run."

THE REAGAN GRATE BAR CO., of Philadelphia, Pa., have contracted with the Boston & Northern St. Ry. Co., of Boston, Mass., to supply them with all grates required in their numerous power stations. This is a big order when it is understood that from 8 to 15 are required in each station.

THE FIRM OF A. L. IDE & SONS, Springfield, Ill., announce that they have established a New York office at 11 Broadway, through which all export, New England and Middle States business will be transacted hereafter, the management being entrusted to Mr. J. G. Robertson.

THE ADVENT OF MODERN fire-proofing precautions, the renewed demands for the safeguarding of the public at large, the exigences of strict sanitary conditions, call for something in the line of building construction which will meet the requirements as stated above to a high degree of thoroughness and economical stability. The H. W. Johns-Manville Co., 100 William street, New York, manufacturers of asbestos and magnesia fire-proof materials, have put forth their efforts to this end, to produce a material which can be adopted by the modern architect, builder, engineer and mechanic; something, which, in itself, will take the place of wood and other inflammable and non-heat, acid and moisture resisting materials. It is known as Transite asbestos fire-proof lumber. The manufacturers will be pleased to give any further information regarding it.

THE BURT MFG. CO., Akron, O., have just made a shipment of 21 of their oil filters to their agency at Havana, Cuba. They report that according to present conditions Cuba will afford a very profitable field for American manufacturers. They have also worked up an extensive export trade in many other countries, and have recently made a shipment of 9 oil filters and 6 exhaust heads to their agency at Sydney, Australia, 18 oil filters to their agency at St. Petersburg, Russia, 3 oil filters to their agency at Calcutta, India, 4 oil filters to Spain, and 2 20-inch exhaust heads to their agency at London, England.

THE MIKADO'S MEN know how to select the good machinery as well as to fight; at least the Lagonda Mfg. Co., of Springfield, O., interpret the matter in this way, owing to the fact that they have recently had an order for a large shipment of boiler tube cleaners, which came through their New York office, of which Mr. C. A. Gillett is manager. This is not the first shipment of the kind that has been made, sample machines having been previously sent, of which this order is a result. It comes through an importing house in New York, and shipment is made direct to Tokyo, Japan. The Lagonda Mfg. Co. are to be congratulated on this business. Their cleaners seem to be gaining a strong hold wherever introduced, and this is a fact not only in Japan but in other foreign countries, and their machines, they tell us, are used in nearly every country on the face of the earth. In addition to tube cleaners, they manufacture a line of specialties: tube cutters, damper regulators, and reseating machines.

FREE.

One 8-inch Stillson pipe wrench will be given to every engineer who sends $1.25 for recipe for a first-class metal polish and boiler compound. William Inman, 202 Madison street, La Porte, Ind.

BOILER COMPOUND.

Mail one dollar for confidential recipe for valuable boiler compound. Twenty years in use. Any druggist can fill it. 50 gallons cost less than $5. Address L. G. Miller, 1825 N. Delaware St., Indianapolis, Ind.

The Relief Valve.

A certain young man of great gumption
'Mongst cannibals had the presumption
To go — but alack,
He never came back;
They say 'twas a case of consumption.
—*Yale Record.*

Motto of the circus manager: Give every man a show.

The cook is at the head of the department of the interior.

"Marriage is a lottery, young man."
"Is it?"
"It is."
"Then, sir, I would like a ticket on your daughter."

Radium, according to scientists, permeates everything i
vicinity. There must be radium in onions.—*Washington P*

The Maid—Of the men of your acquaintance who
married, which do you think are the happiest?

The Bachelor—The dead ones.—*Chicago News.*

Giffle—The lady barber is rather forward, isn't she?

Spinks—Guess not. I never see her talking to any cust
that she doesn't know.

Giffle—Still she scrapes a good many acquaintances.—*P
delphia Bulletin.*

Goodman—Then you don't think marriage is a good thin

Kratchell—For some men it is absolutely necessary.
men, you know, simply can't be happy unless they're fig
all the time.—*Philadelphia Ledger.*

"Yes, sir, he was the laziest man on record. What do
reckon he did when his house was on fire?"

"Dunno."

"Warmed his hands at the blaze and thanked God he d
have to split the wood for it!"—*Atlanta Constitution.*

"There goes a typical Georgia cracker," said the native.

"Indeed!" exclaimed the Northern visitor. "Goes i
moonshine whiskey and all that sort of thing, I suppose?

"No; that fellow happens to be a Prohibitionist."

"Ah, a regular water-cracker."—*Philadelphia Press.*

Lawyer (to witness)—Never mind what you think.
want facts here. Tell us where you first met this man.

Woman Witness—Can't answer it. If the court doesn't
to hear what I think there's no use questioning me, for
not a lawyer and can't talk without thinking.

Two newspaper writers who usually breakfast about
entered a down-town cafe last Saturday. One looked a
other and asked: "What are you going to eat?"

"Oh, some eggs, I guess," replied his friend.

"I'm rather afraid of them. How do you tell a bad e
The remark seemed innocent enough, but his friend
"Just let me give you a tip—if you have anything to tell
egg, break it gently."

Mrs. Flaherty stepped off the scales in the back room o
grocery store as soon as she had stepped on. "Sure,
scales is no good f'r me," she said in a tone of deep dis
"They only weigh up to wan hundred, an' I weigh wan
dred an' nointy pounds." "It's easily discouraged ye
said her companion, Mrs. Dempsey, cheerfully. "Just st
to thim twict, me dear, and let Jamsey, here, do th' su
ye."—*The Presbyterian.*

"You must find that impediment in your speech rathe
convenient at times, Mr. Briggs?"

"Oh, n-no; everybody has his little peculiarity. Stamm
is m-m-mine; what is y-yours?"

"Well, really I am not aware that I have any."

"D-do you stir y-your tea with your right hand?"

"Why, yes, of course."

"W-well, that is your p-peculiarity; most p-people u-
t-teaspoon."—*The Watchword.*

ave Your Steam

BY USING A

FISHER GOVERNOR

on your Steam Pump. Positive in its action. Prevents an over pressure in the tank or discharge main. For Hydraulic Elevators, Fire, Boiler Feed and any pump where the discharge pressure is to be regulated. If you want to know more about them write.

The Fisher Governor Co.

1202 Main St., West
Marshalltown, Iowa

HAVE YOU BEEN DISAPPOINTED

with the boiler compounds you have tried? There are poor ones we admit, but don't let that prejudice you.

JUST TRY THE

International Boiler Compound

and we have no fear of results. We have a special offer for engineers. Write at once.

International Boiler Compound Co.

47 Market St., CHICAGO.

☞ This compound is the only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING

Absolutely Will Not Gum the Brushes.

It will put that high gloss on the commutator you have so long sought after.

50 Cents per Stick. $5 per Dozen.

Upon receipt of this COUPON we will send you FREE a Sample Stick.

Name ....
Address ....
E. R.

FOR SALE BY ALL SUPPLY HOUSES
OR
K. McLennan & Co.
SOLE MANUFACTURERS
Inter Ocean Bldg., Chicago

THE SWARTWOUT CENTRIFUGAL
CAST IRON
XHAUST HEADS AND STEAM SEPARATORS

EFFICIENT **SIMPLE** **ORNAMENTAL**

The Swartwout Cast Iron Exhaust Head will neither wear out nor rust out. It is efficient and lasts a lifetime. Can you ask more?

THE SWARTWOUT VERTICAL STEAM SEPARATOR PAT'D AUG 16, 1904

The Swartwout Vertical Steam Separator is simple in construction and positive in its operation. Centrifugal force does it. Sold on trial to responsible parties.

The Ohio Blower Company,
Manufacturers
CLEVELAND Dept. S-3 **OHIO**

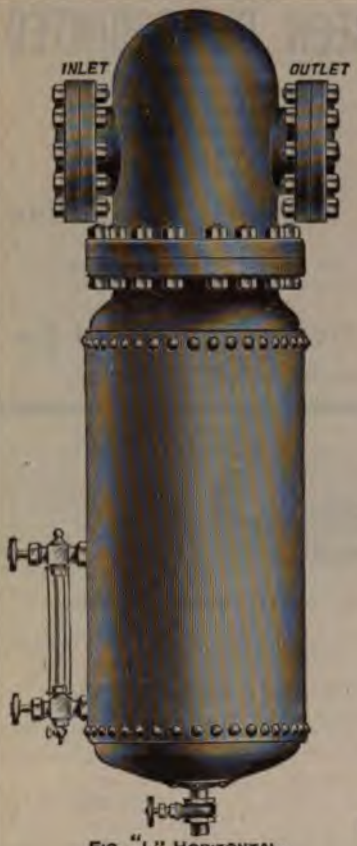


FIG. "L" HORIZONTAL.

The Purchaser of a Steam Separator

needs to discriminate with unusual care, for there are many makes and all bear the hackneyed label "The Best Made."

Each may be meritorious in one or more features, but sadly lacking in the complete make-up. Such separators soon prove detrimental to the user and he is forced to look for a better machine.

Now, if you, Mr. Reader, are contemplating the purchase of a separator, will you not carefully study the advantages offered by the extensive line of

AUSTIN SEPARATORS
FOR LIVE AND EXHAUST STEAM?

Remember, that we manufacture separators adapted for every condition of service. Based upon exact scientific principles, we can positively guarantee their efficiency as separating machines.

Our Steam Separators insure absolutely dry steam to the engine, smoother running, protection against water getting into the cylinder, and extra steam storage because of their large receiver capacities, so that extra steam is instantly available, close to the throttle, in case of a sudden increase of load.

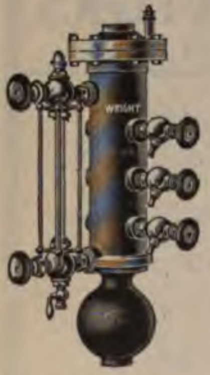
Our Oil Separators extract all oil, grease and other impurities from exhaust steam.

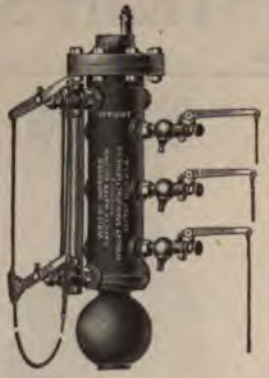
AUSTIN SEPARATOR CO.

90 Woodbridge Street, Detroit, Mich., U. S. A.

Sound Reasons of Dollars and Cents

DEMAND THE USE OF





Wright Improved Safety Water Columns

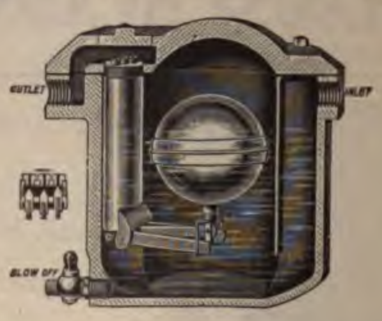
They SAVE COAL, SAVE WATER, SAVE BOILER REPAIRS and SAVE WORRY. Engineers who use them would not be without them. Better write for particulars.

Wright Manufacturing Co.

82 Woodbridge Street, DETROIT, MICH., U. S. A.

The Heart of a Steam Trap is the Valve Section

SEE HOW EASILY IT IS REACHED IN THE



Wright Emergency Steam Trap

No bother if you want to clean or renew the valves. Unscrew plug over tube and take out valve seats with a screw driver—five minutes work, that's all. By long odds the most simple and practical trap made. And its superiority doesn't end there, either. We claim that it has no equal for handling large quantities of water instantly without waste of steam. Let us send you full details.

Wright Manufacturing Co.

82 Woodbridge Street, DETROIT, MICH., U. S. A.

YOU WANT THE BEST.

Warren's Pulley Cover is the best and most economical money saving article that can be used where power is transmitted by belts over pulleys. A trial proves it. Sold in convenient packages—125 sq. ft., $12.00; 40 sq. ft., $5.00 F. O. B., Chicago, net 30 days. If desired, working sample sufficient for 4 sq. ft. will be sent by prepaid express upon receipt of $1.00.

THE WARREN CO., Inc., Mfrs.
27 E. CHICAGO AVENUE, CHICAGO.

RANE VALVES
ESTABLISHED 1855

THE USE OF THE
eliance Safety Water Column
INSURES, AMONG OTHER THINGS

Steady Water	Less Repairs
Steady Power	Less Stoppages
Steady Steam Pressure	Less Fuel

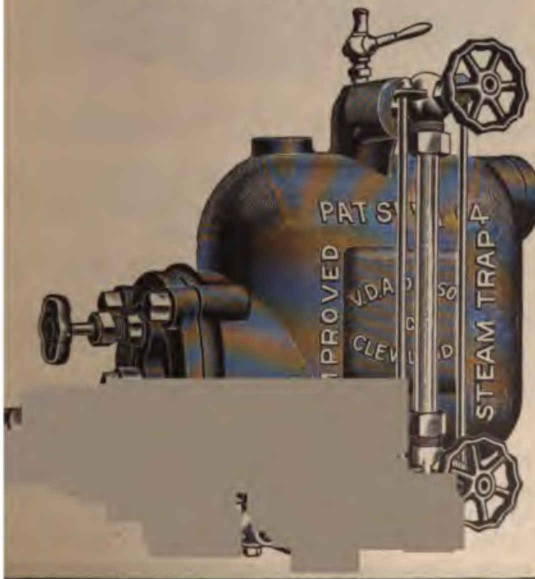
Less Expansion and Contraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

WRITE US FOR FURTHER INFORMATION

he Reliance Gauge Column Co.
. PROSPECT ST. CLEVELAND, O.

he Standard Steam Trap of America
IS THE
NDERSON
MANUFACTURED BY
THE V. D. ANDERSON CO.
CLEVELAND, OHIO.



This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.
SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.
Albany, N. Y., U. S. A.
Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

REMEMBER! This is STEAM TRAP season.

If that old trap is wasting steam and not doing its work, replace it with the

H. H. Steam Trap

and have no more trouble or expense. We guarantee it to give satisfaction or pay freight both ways.

Send for our catalog.

JAMES McCREA & CO.
Manufacturers,
67 W. Washington St. CHICAGO.

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Wright Mfg. Co.

0 DAYS' TRIAL
O PROVE OUR CLAIMS

uggles Perfection
Flue Cleaner

will quickly prove its worth in any plant.

It is the simplest cleaner on the market—being made of two parts.

No screws or rivets used in its construction. Sharpens itself. Absolutely cleans the flue. It is strong and reliable.

Send for one on trial.

UGGLES & RUGGLES,
Batavia, Illinois.

FOUR APPLIANCES
WITH BUT A SINGLE PURPOSE
L BUILT TO SAVE MONEY AND DO IT
FIRST THERE'S THE

einland Tube Cleaner

Gold Medal Winner at St. Louis, and winner wherever used. the cleaner the other fellows try to copy. We'll sell IT, or Power en Cleaners, or clean your boilers on contract.

TUBE CUTTER.

Cuts off tubes at any point—neatly, cleanly—without burr or ling. It costs little.

DAMPER REGULATOR

Controls damper in stack and stops waste.

RESEATING MACHINE.

Cleans header faces, nuts and caps quickly, perfectly.

he Lagonda Manufacturing Co.
SPRINGFIELD, OHIO.
oiler Cleaning Experts." "At it 20 Years."

Y YORK. PITTSBURG. LONDON, ENG.

Try the
Trimo

The Trimo Pipe Wrench

Drop-forged from the best steel. Grips the pipe firmly, but cannot lock on it. The jaws when worn, can be easily and cheaply replaced. In eight sizes which will handle up to 5-inch pipe.

The Trimo Bulldog Chain Wrench

The greatest strain comes on the ***handle,*** not on the ***jaws,*** thus giving much greater strength than any other make. Drop-forged. Flat link or cable chain. Seven sizes for pipe up to 12 inches in diameter.

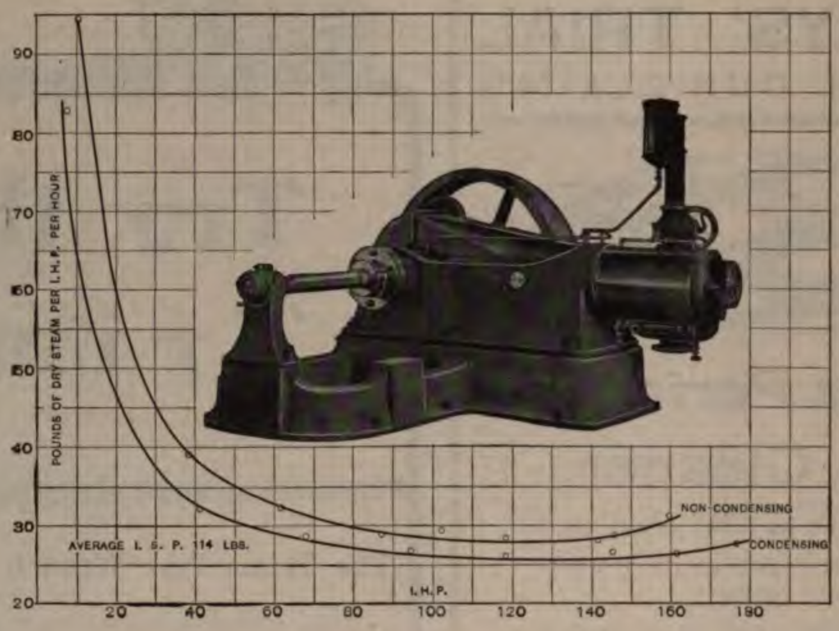
The Trimo Pipe Cutter

Obviates time-wasting filing of pipe. The rolls remove all burr ***while pipe is being cut.*** Can be quickly converted into a 3-wheel cutter. Three sizes for pipe up to 3 inches in diameter.

All Trimo tools are sold under the broadest guarantees. It will pay you to investigate.

Send for Catalogue today

TRIMONT MFG. CO.
Roxbury, Mass.



"Reeves" Curves are Curves of Economy

And they can be produced by the Reeves Simple Engine in your engine room as readily as they were in

Exacting Tests at Cornell University

By Professors Carpenter and Diederichs.

For they were made there with an ordinary shop engine, exactly like those we are shipping to our steadily lengthening list of customers—exactly like the one we hope to ship to you in the near future. With an economy of **28 pounds noncondensing, and 26 pounds condensing,** giving nearly constant range from 40% underload to 40% overload,

The Reeves Simple Engine Has Set The Pace

for engines of its type and demonstrated that it is well in advance of present practice, without a single device of doubt or radical departure from the most approved engineering methods.

Send for detailed report of tests and get the true definition of economy, as applied to a simple engine.

Reeves Simple Engines, vertical and horizontal, 18 to 300 I. H. P.; Reeves Vertical Cross Compounds, 10 to 700 I. H. P.

The Reeves Engine Co.

85 Liberty St. NEW YORK.

Philadelphia Office: Land Title Building, Tel. 2198 Spruce. Chicago Office: 1612 Monadnock Block, Tel. 5060 Harrison.

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Coils and Bends, Iron, Brass or Copper Pipe
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Russell Engine Co.
Exhaust Heads
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Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.

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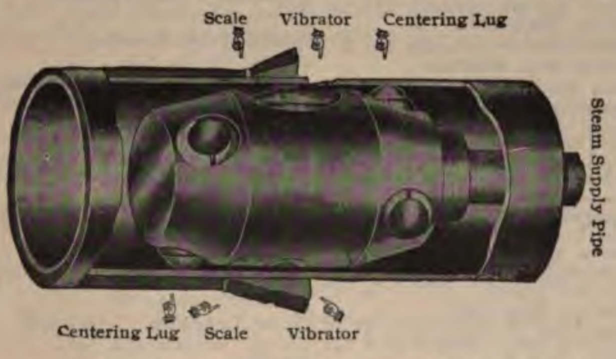
he "Torpedo" Cleans SAFELY and THOROUGHLY



We ask you to give us a chance to show you that the "TORPEDO" is the only device on earth can get all the scale from your fire tube boilers, and with entire absence of any harmful or straining cts on the tubes.

The strongest man is harmless when you restrict his arm movement to only ¼ or ⅜ of an inch. s is the stroke of the "TORPEDO" and each rap is cushioned by the yielding centering lugs. The ORPEDO" is an absolutely perfect machine and has only one moving or working part.

We are awaiting word from you, giving size of tubes, so that we can send you a "TORPEDO" a trial on "suspicion." Write today or wire us, collect.

THE GENERAL SPECIALTY CO.

Carroll Street, BUFFALO, N. Y.

CLEAN BOILERS GUARANTEED

The engineer's labor in keeping boilers clean can be lessened 25 per cent by the use of

Red Star Boiler Compound

It is always satisfactory.

W. S. Sohn Brewing Co., Cincinnati, O., write:—"Your brand of Red Star Boiler Compound excels any boiler preparation we have ever used. It certainly contains all the elements necessary to remove scale without injury to the boiler."

We furnish an automatic compound feeder to those who desire it.
You can get it free. If you want to know how, write us.
Our 96-page book will be mailed free if you mention this paper.

Address "Dept. ER."

Lake Erie Boiler Compound Co.
Buffalo, N. Y.

BRANCHES: New York City, Newark, N. J., Cincinnati, Philadelphia, Pittsburg, Kalamazoo, Birmingham, Ala., Louisville, Ky., New Orleans.

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France Packing Co.
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Packing, Sheet and Fibrous
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Gould Packing Co.
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Pencils and Crayons
Dixon Crucible Co., Jos.

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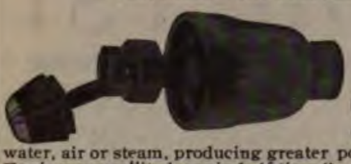
"THE LIGHTNING" TUBE CLEANER

That cleans Water Tube and Tubular Boilers,



Combines the Striking and Rotary Actions.

Has the only

COMPOUND MOTOR WHEEL

That runs equally well with water, air or steam, producing greater power, with ⅓ to ½ less water. Engineers say "it cleans in half time."

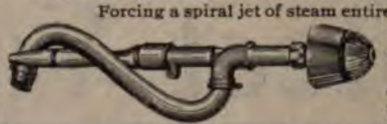
Manufacturers of Boiler Head Cap and Nut "Reseater and Cleaner," X Ray Oil Purifier, Perfect Expansion Flue Brush. All distinct in their class.

MAURER, LABADIE & CO.

215 St. Joe Street, SOUTH BEND, IND.

Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.



Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO.

CENTURY

The Original White Packing.

FOR SALE BY LEADING SUPPLY HOUSES.

SEND FOR CATALOGUE OF

INDICATORS, REDUCING WHEELS, PLANIMETERS, SEPARATORS, ETC., ETC., TO

Lippincott Steam Specialty & Supply Co.,

NEWARK, N. J.

OUR OFFER OF A

FREE INDICATOR

with our course of Indicator Instruction (by mail) will soon be withdrawn. If you are an engineer desirous of learning indicator work "to a finish," and wish to get a fine Indicator outfit to practice with, you should read our ad in the Engineers' Review for March, and then write for further particulars, which are free. Address

A. C. LIPPINCOTT

GENERAL MANAGER OF

INDICATOR INSTRUCTION CO.

93 GREEN ST., NEWARK, N. J.

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Pumps, Oil
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Twines and Cordage
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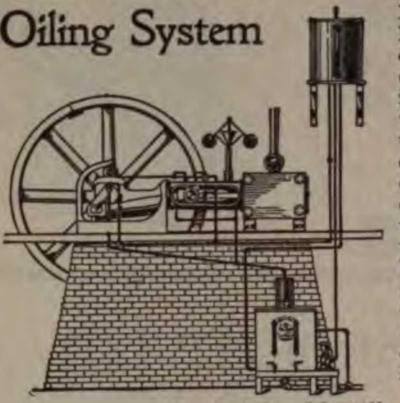

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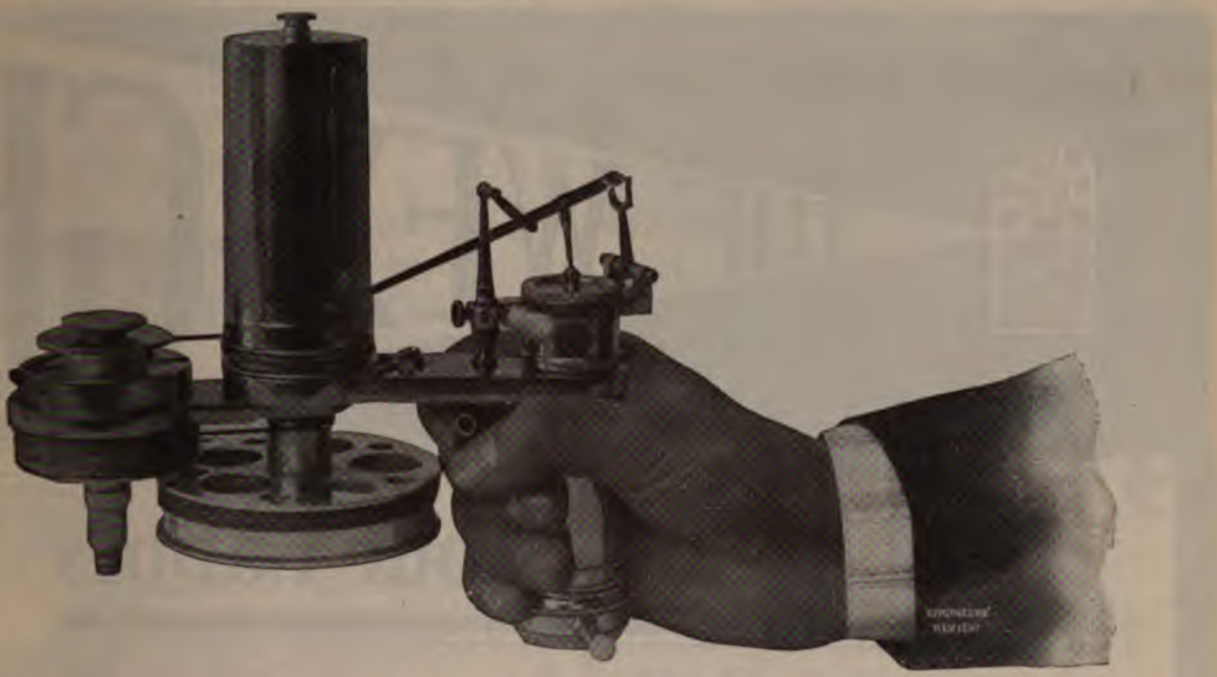

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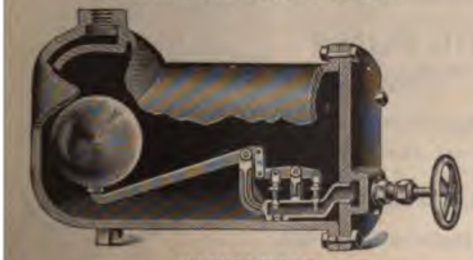
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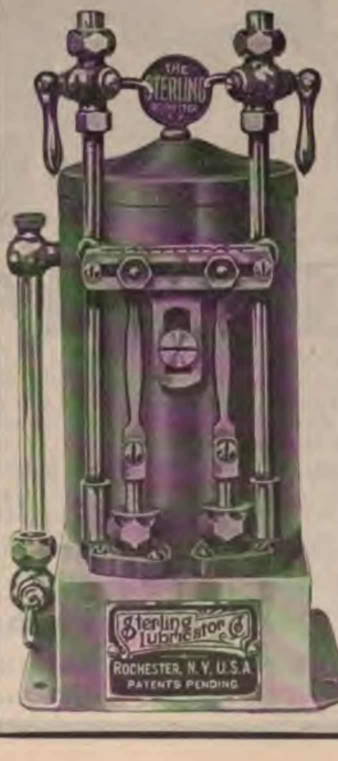

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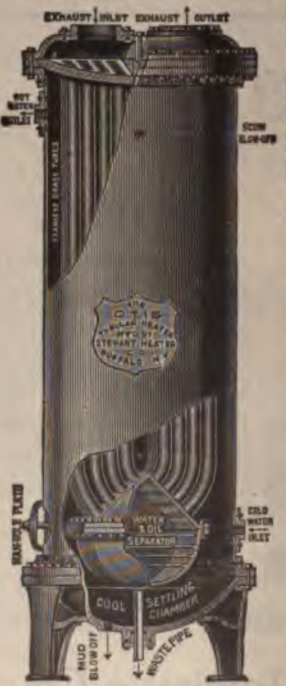

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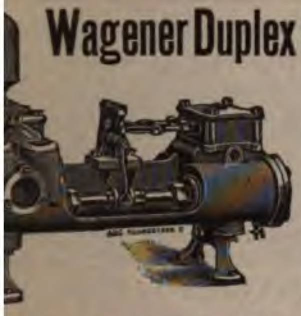

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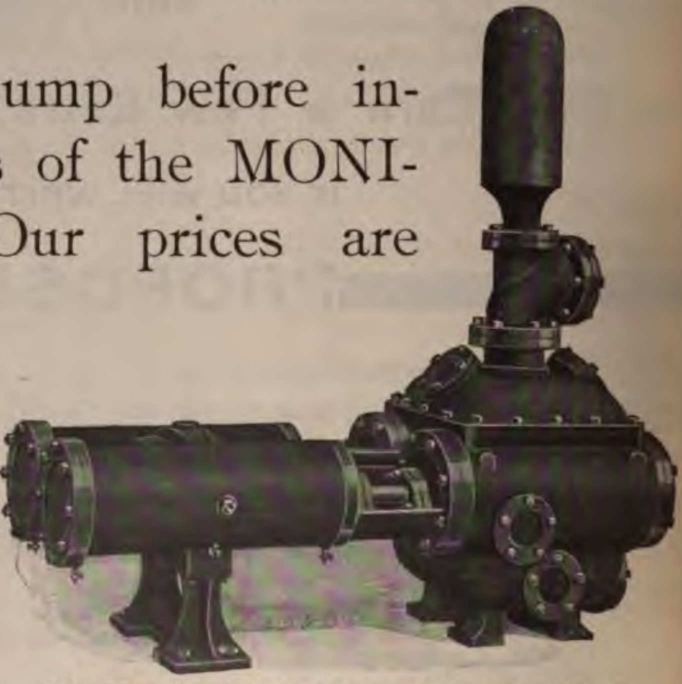

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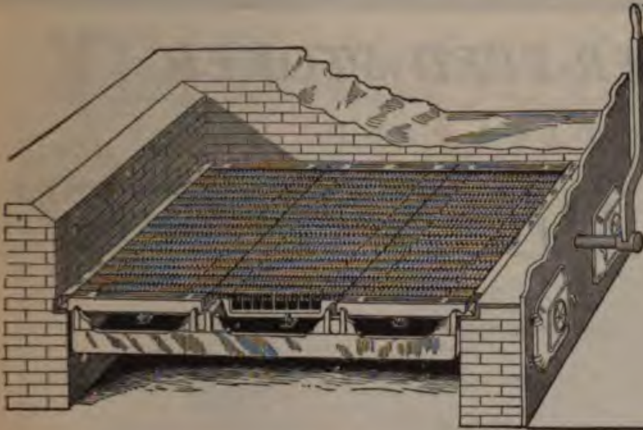

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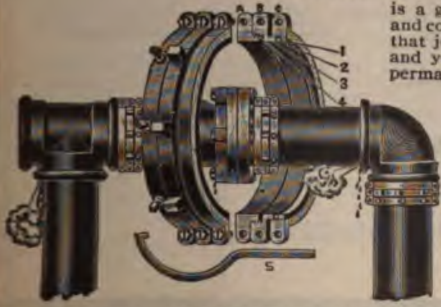

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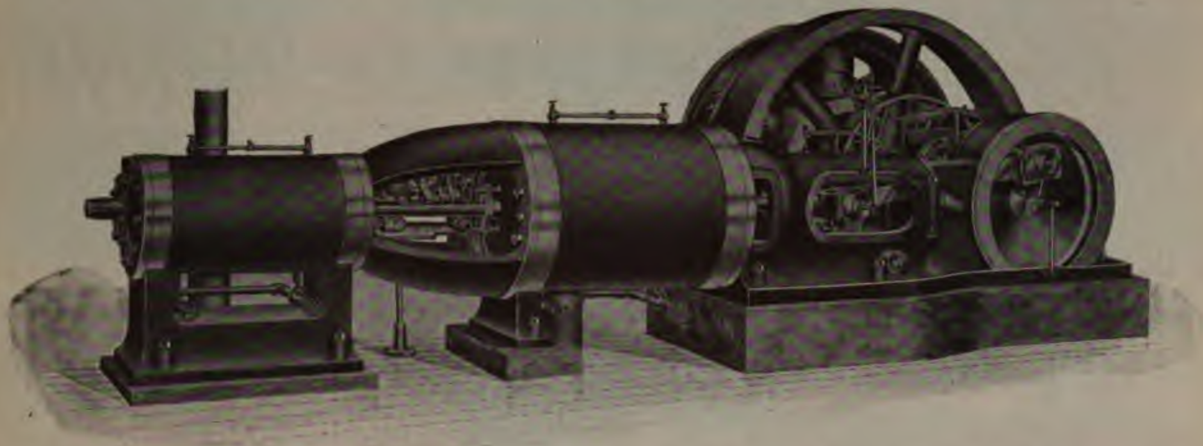

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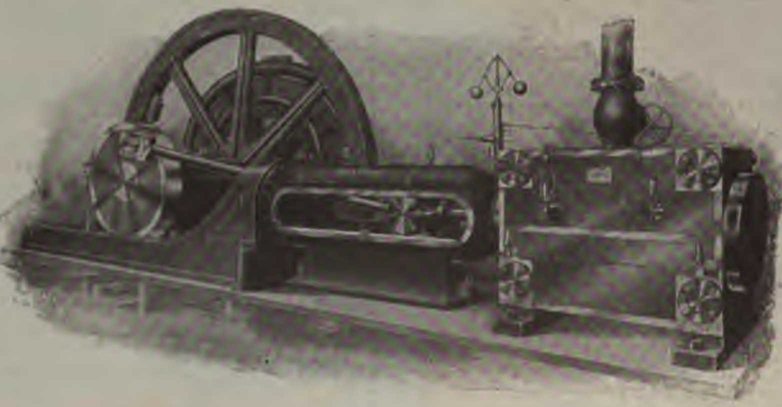

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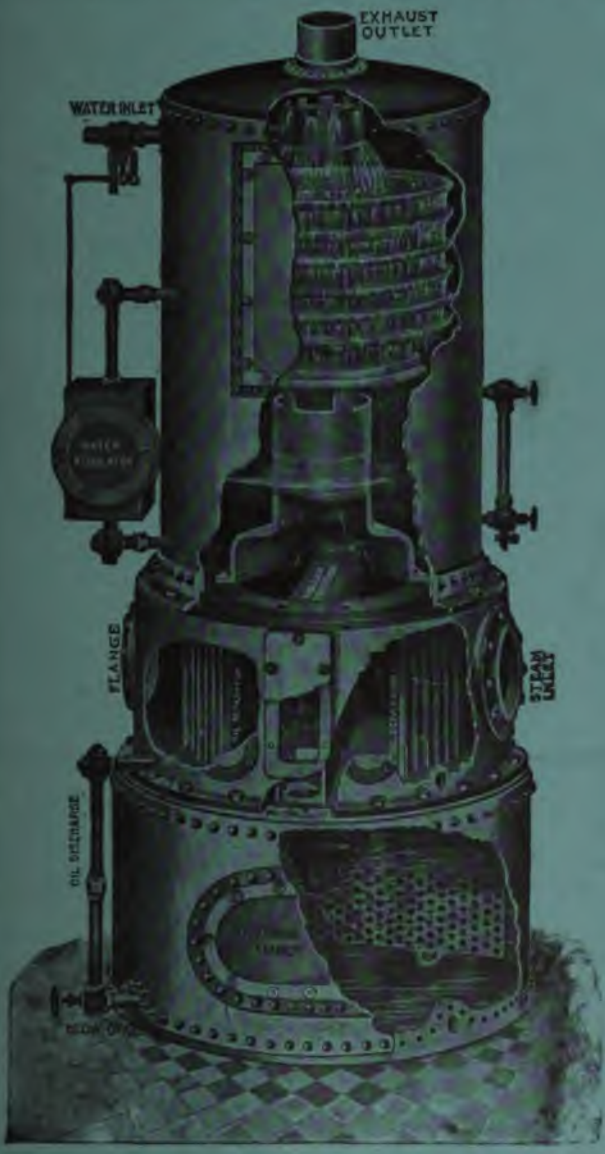

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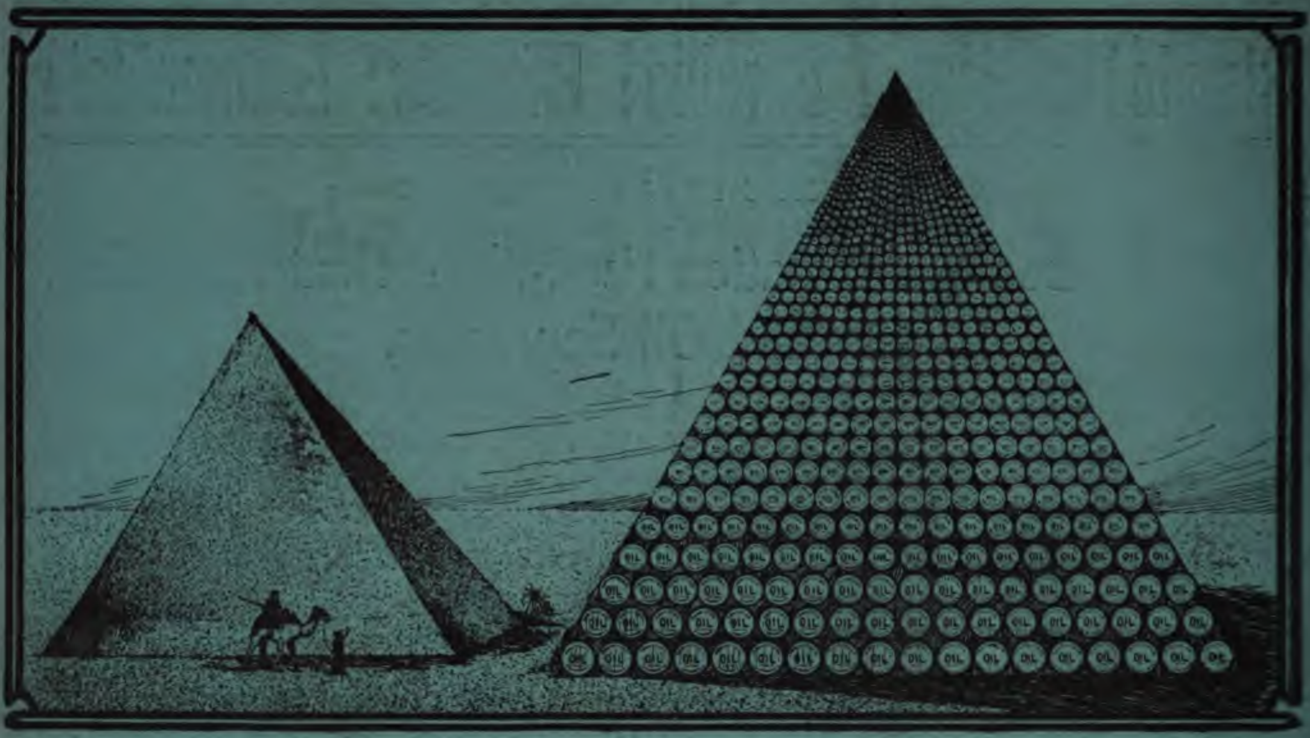

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ENGINEERS' REVIEW

Vol. 16
No. 2

CLEVELAND, APRIL, 1905.

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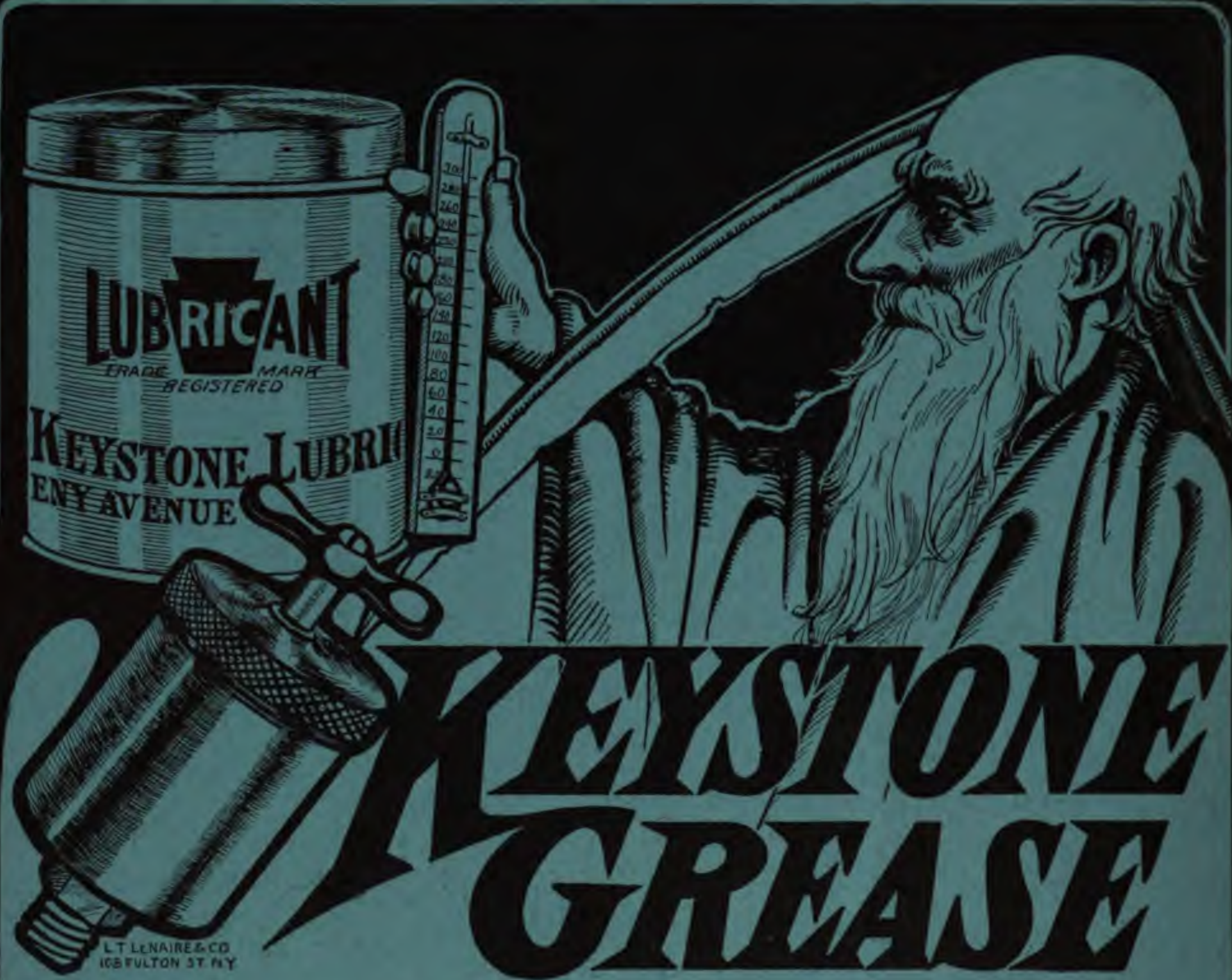

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ENGINEERS' REVIEW
FOR STATIONARY ENGINEERS
VOL. 16. CLEVELAND, APRIL, 1905. No. 2.

A DISASTROUS BOILER EXPLOSION.

Not since the falling of the Pemberton mills in Lawrence, January 10, 1860, has there been such a disaster in New England as the boiler explosion which occured at the R. B. Grover Co.'s shoe factory, Brockton, Mass., early Monday morning, March 20, in which 57 persons lost their lives, by flying missles or cremation as they were caught in the wrecked building which almost immediately became a seething, roaring furnace. Fig. 1 shows that the destruction of the Grover plant is complete. Nothing remains but a mass of twisted iron and charred embers of the once four-story factory.

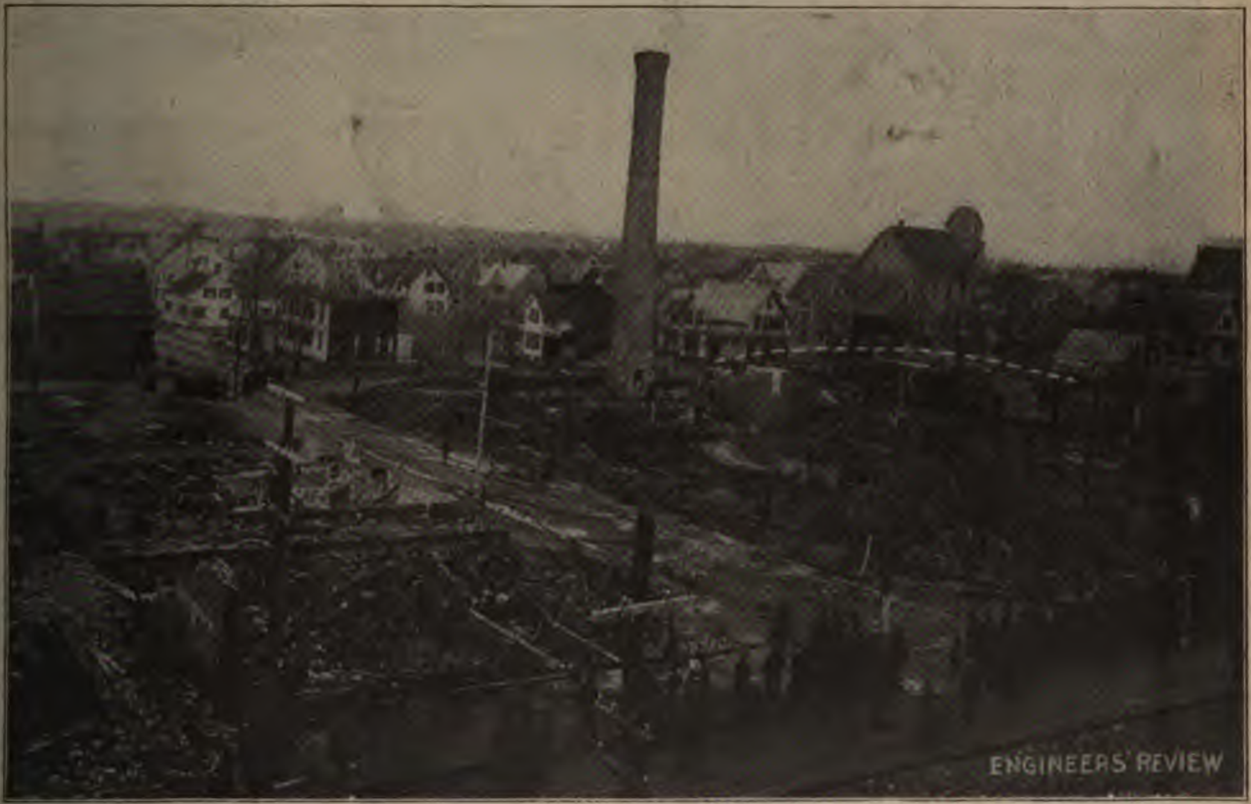


FIG. 1. SHOWING THE COMPLETE DESTRUCTION OF THE R. B. GROVER PLANT AND FLIGHT OF THE BOILER.

According to the statement of the night engineer, the exploded boiler was used for the first time early Sunday morning, after laying idle all winter, in order to wash out the other boiler. The boiler as far as the night man knows was in good condition and contained sufficient water when he was relieved by the day engineer.

Engineer Rockwell's body was not found for about 24 hours after the explosion, when the headless trunk of the unfortunate engineer was found under a mass of brick, earth and embers. The body was laying head away from the boiler setting, with the feet almost touching the brick work in what was once the boiler room, and was so badly charred that it could not be identified for a certainty, the only marks of identification being the rubber heels on the shoes, a watch battered and bent, and a finger nail clipper. These coupled with the location of the body leave little doubt as to the identity. Under the body was found the seat of the wooden chair in which, about five minutes before the boiler explosion, Rockwell had last been seen sitting by his wife, who could see into the engine room from her residence. At that time he was leaning back in the chair with his hands clasped behind his head, a favorite position with engineers when taking things easy.

It is stated by Channing Howard, who was employed as head shipper by the R. B. Grover Co., that at 7:35 o'clock on the morning of the explosion he went to the boiler room to borrow an oil can, which he took to his department, and after using it returned it to Mr. Rockwell. On his first visit to the boiler room, engineer Rockwell was working with his fires; on the second visit he was sitting in his chair talking to a friend, who appears to have been Mr. J. P. Gibbs, assistant engineer at the sewerage pumping station, who left the boiler room a few minutes before the explosion. He states that the steam was below the safety limit, and that there was plenty of water in the water glass at that time. There is little doubt that the boiler contained plenty of water; this is quite evident from the fact that the fusible plug was all right. The force of the explosion also indicates sufficient water.

Mrs. Rockwell, the widow of the dead engineer, states that her husband had been afraid of the old boiler for some months, as he did not consider it fit for use with a high pressure and did not like the idea of running it at such a high pressure as was necessary in order to do the work. Mr. Rockwell operated under a first class engineers' license, and had been employed as engineer for about 12 years.

There were two boilers in the boiler room, one laying north and south, which was the old one which exploded. The other boiler laying at a right angle to the first was a new one, built in 1903. Of the two boilers, one was used as a high pressure, and the other a low pressure; both were built by Edward Kendall & Sons, Cambridge, Mass., who are well-known manufacturers of return tubular boilers. The low pressure boiler, the one that exploded, was built in 1891. It was constructed with doubled riveted lap joint seams and was allowed to operate at 90 pounds steam pressure which was supposed to be safe with that kind of seam. It was 72 inches in diameter, 17 feet long and contained 140 3-inch tubes, 16 feet long. The safety valve was a 5-inch lever valve, the feedwater entering at the top in the usual manner through a feedpipe 1½ inches in diameter. The boiler had a grate surface of 36 square feet. The high pressure boiler, not in operation at the time of explosion, was also 72 inches in diameter, but was more strongly constructed than the one which exploded, being made with butt joints. It contained 138 3-inch tubes, 18 feet long and was allowed to carry 125 pounds steam pressure.

It is evident that the accident is one for which no one can be held responsible. The boiler had been inspected internally once each year and externally every three months. The last internal inspection was made Dec. 28, 1904, and the last external inspection Feb. 24, 1905, at which time the boiler was found to be in good condition and fully equipped with all of the necessary appliances. The verdict of the Hartford Steam Boiler Inspection & Insurance Company's inspector is that the cause of the explosion was due to an old flaw in the plate as shown in Figs. 8 and 9. This was also the finding of the coroner's inquest. As will be seen, the crack started on the inner side of the outer plate and extended along the rivet holes, Figs. 2 and 3, and therefore was practically impossible to detect.

Accidents of this kind are not at all infrequent with boilers having lapped riveted seams. In some instances such a crack will develop and make its presence known by "weeping" through the brick work covering the

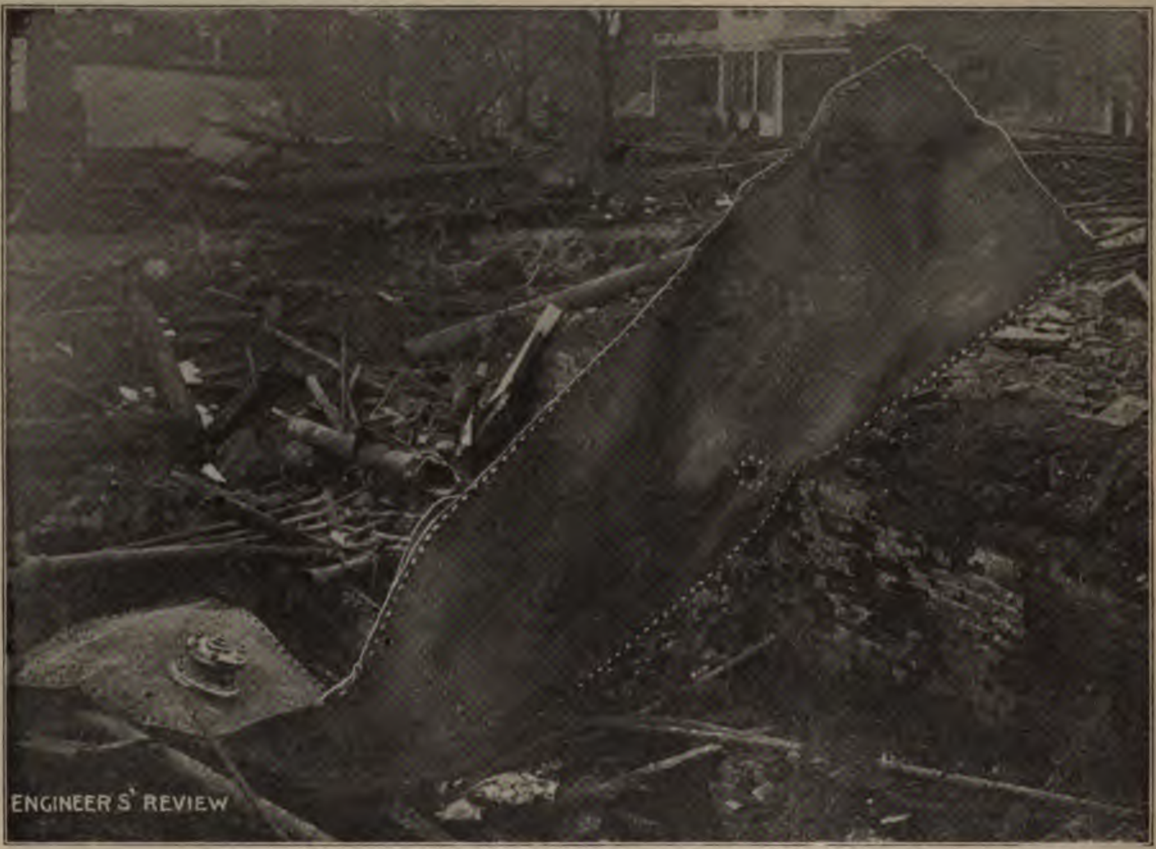


FIG. 2. THE PLATE WHICH GAVE WAY. THE UPPER END SHOWS WHERE THE PLATE CRACKED ALONG THE RIVET HOLES.

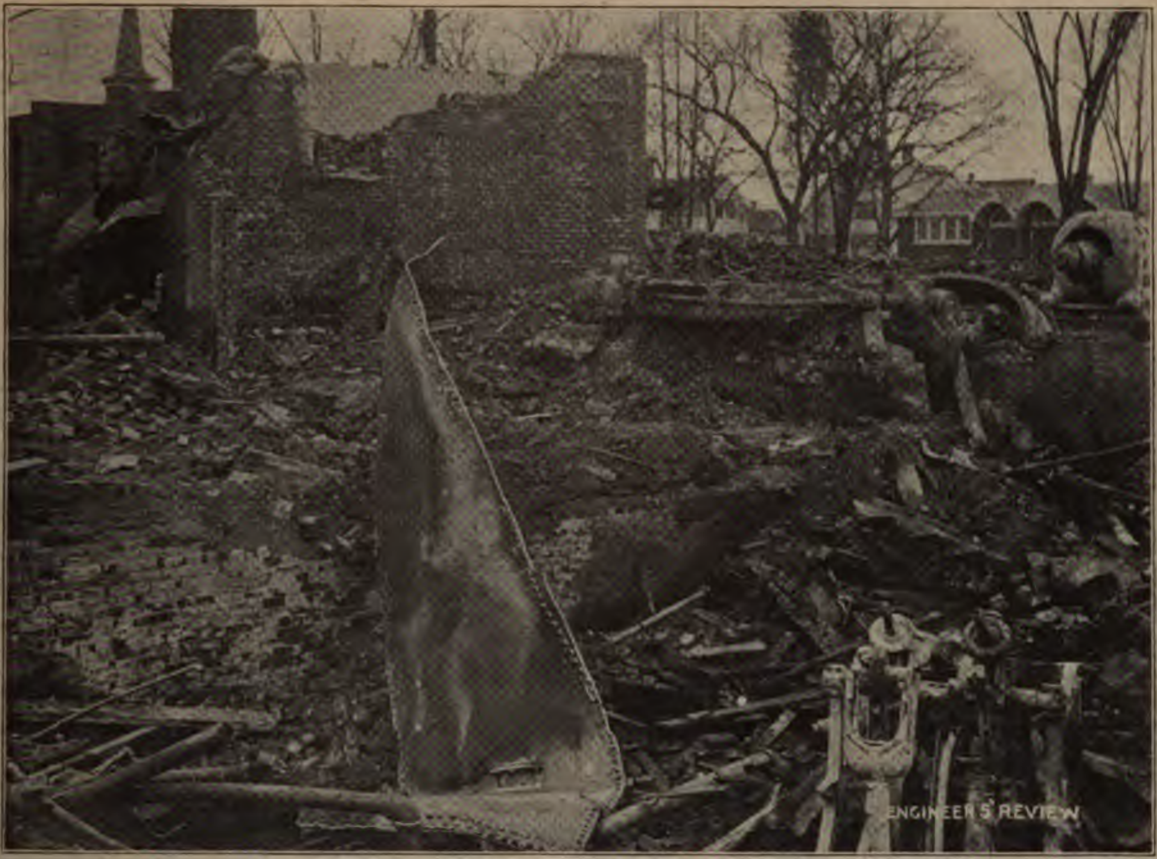


FIG. 3. ANOTHER VIEW SHOWING THE OTHER END OF THE PLATE AND THE POINT OF RUPTURE ALONG THE LONGITUDINAL ROWS OF RIVETS WHICH ARE STILL IN PLACE.

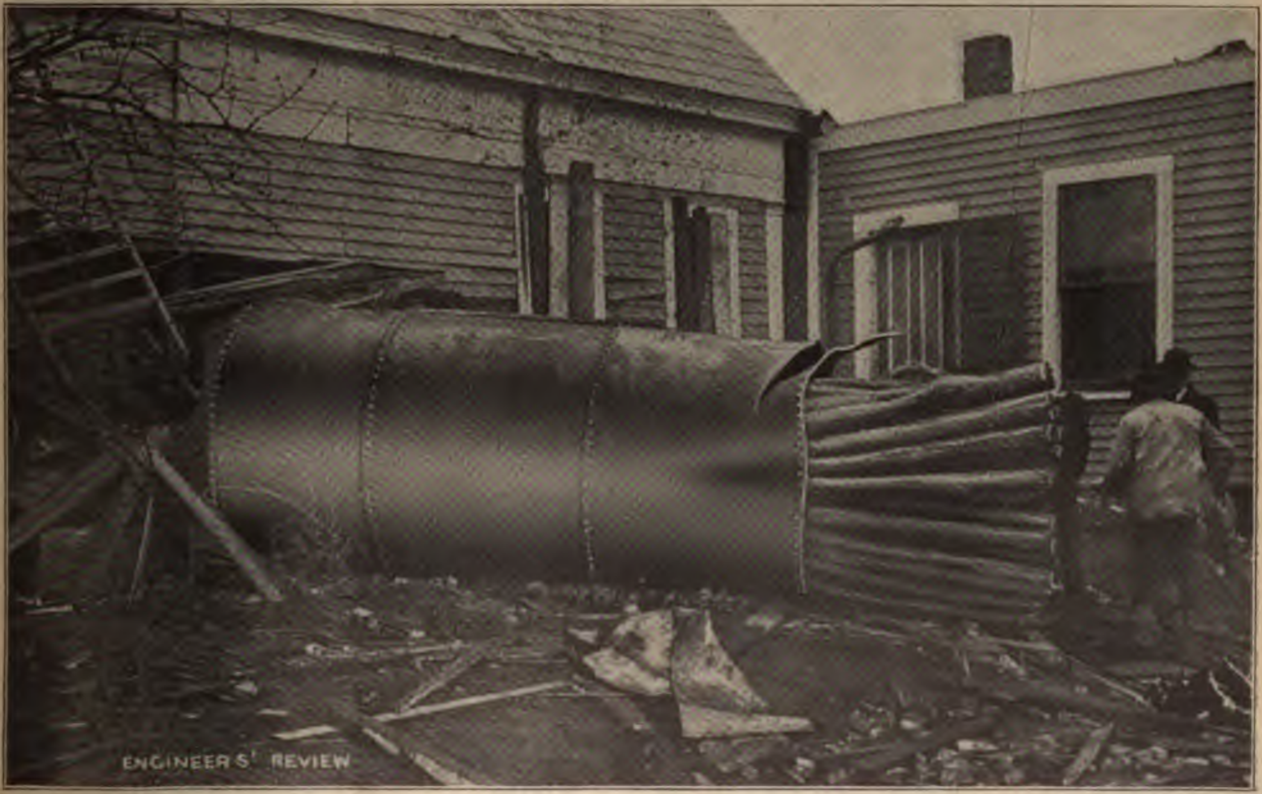


FIG. 4. THE EXPLODED BOILER AT THE HOOD HOUSE, 154 FEET FROM ITS SETTING.

boiler; but in the case of this boiler, it is said there was nothing whatever to indicate the presence of such a crack. The flaw was in the seam of the fourth section of the boiler which was completely blown away, as is shown in illustrations, Figs. 4 and 5.

When the boiler exploded it went through the front of the boiler house and traveled about 154 feet to its resting place shown in Fig 4. The course of its flight is shown in Fig. 10. All of the tubing was drawn out of the rear head and went with the boiler. So great was the force of the explosion that the plate comprising the fourth section was flattened out almost as straight as the day it came from the rolling mill, as shown in Figs. 2 and 3. The flattened plate was found within the demolished boiler house, while the rear head of the boiler was only a short distance away. Figs. 6 and 11 show how the rear head and braces were bent by the force of the explosion.

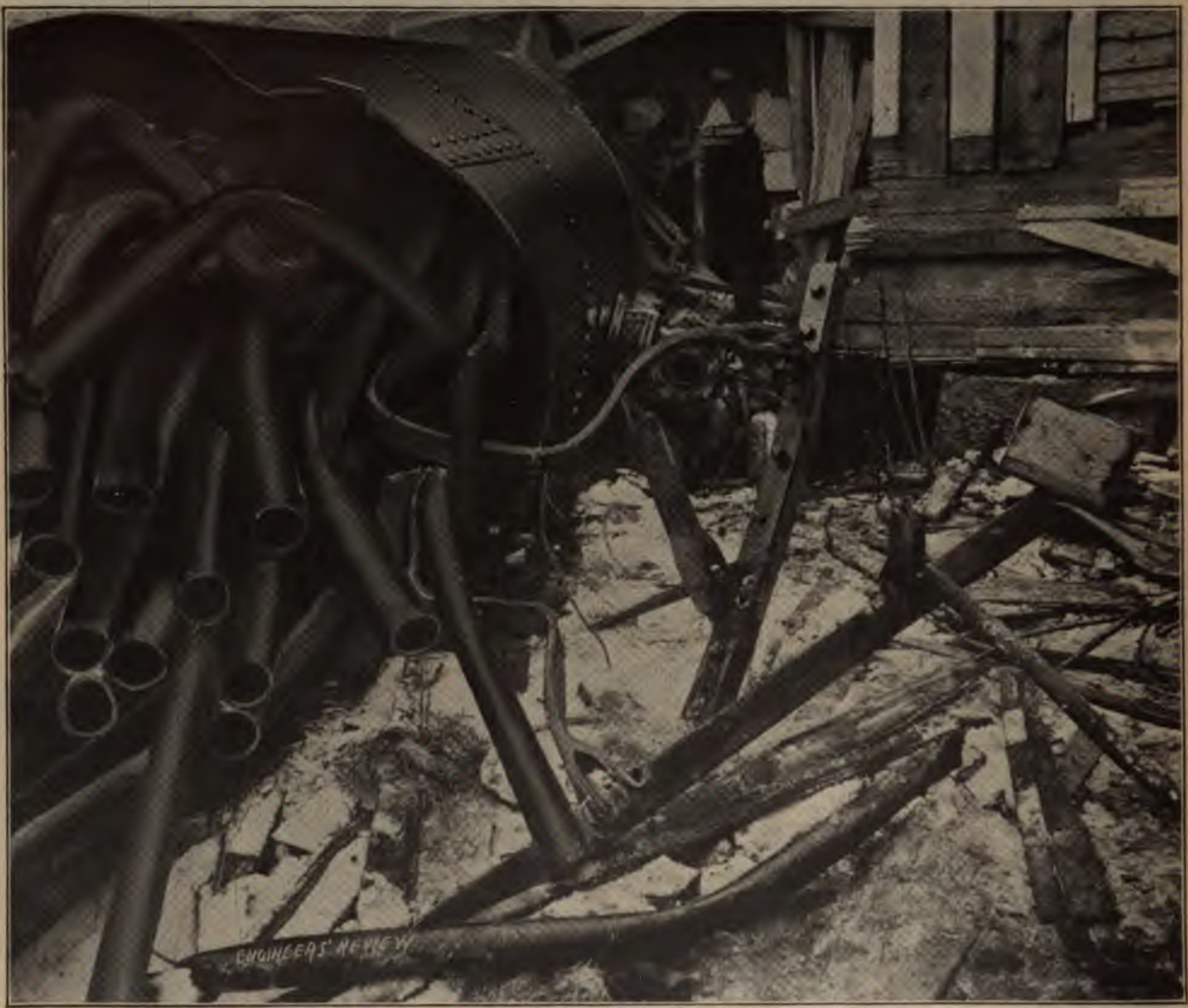


FIG. 5. SHOWING THE TUBES AS THEY PULLED OUT OF THE REAR HEAD.

The force of the explosion blew the boiler northward through the side of the engine room, and taking an upward direction cut through the upper portion of Engineer Rockwell's residence, tearing away the roof over the kitchen and a section of the roof and house down to a point 5 feet from the first floor, as shown in Fig. 12. After passing through the house it cut off a tree 6 inches in diameter, cut off the top of a wagon standing in the yard beyond, and landed in the side of the frame house occupied by a Mr. Hood, penetrating the side of the building about a third of its length and knocking the house bodily three feet from its foundation, Fig. 4.

The boilers of the Grover factory were not subject to the inspection of the district police, as they came under section 2 of chapter 105 of the revised laws, which is as follows: "Whosoever owns or uses or causes to be used a steam boiler, excepting boilers upon locomotives, in private residences, under the jurisdiction of the United States or under the periodically guaranteed inspection of companies which have complied with the laws of the commonwealth, boilers used exclusively for agricultural, horticultural and creamery purposes or boilers of less than three horsepower, shall annually report to the chief of the district police the location of such steam boiler."

It is the practice in shoe manufactories to store gasoline, naphtha, etc., in small sheds in the yard to comply with the fire insurance rules. Just the amount of naphtha, gasoline and cement which is highly inflammable, and other fluids of explosive nature stored, is not known. At the time of the explosion it is probable that not less than two barrels were on hand, and in the naphtha house, which was constructed of wood and was nothing more than a shanty. This shed was situated directly behind the boiler house, and was set on fire by flying coals and red hot bricks when the boiler exploded. An explosion of naphtha followed that of the boiler, and sheets of naphtha flames were thrown upon the building, which in an instant became a roaring furnace. Had it not been for this it is not likely that the number of lives lost would have been more than one-fourth as great. When the explosion occurred, the side of the building next to the boiler

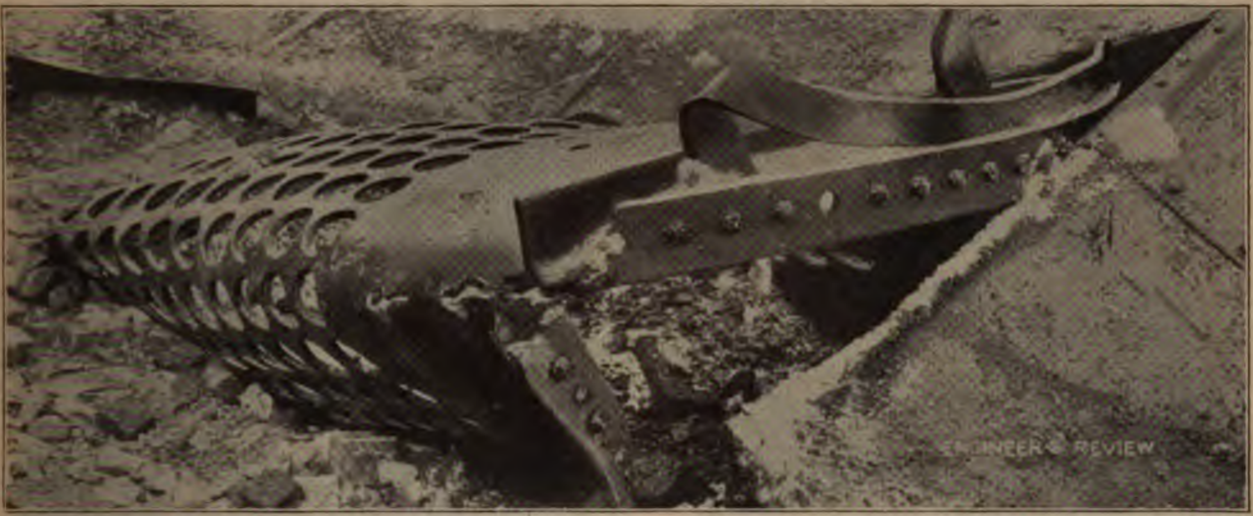


FIG. 6. THE REAR HEAD OF THE BOILER TORN AND BENT.

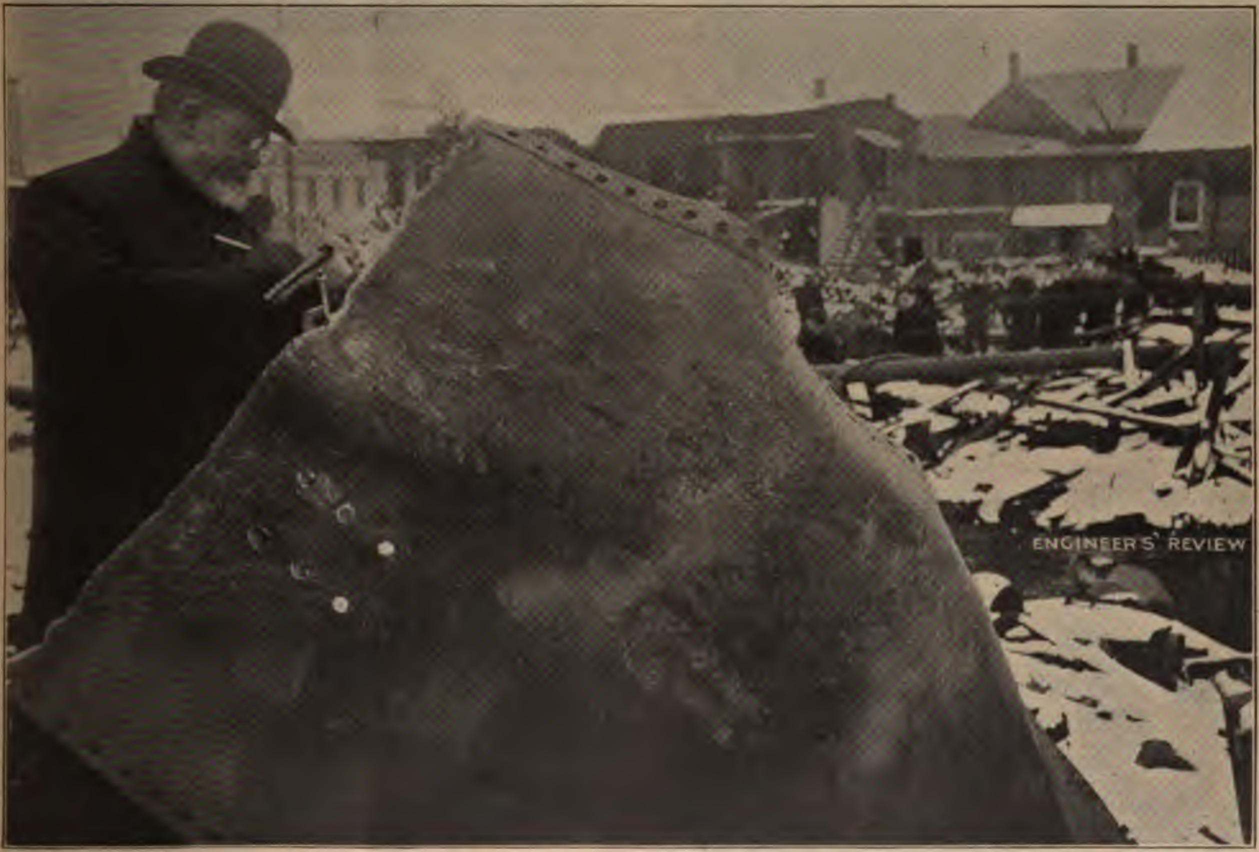


FIG. 7. AN EXPERT GATHERING EVIDENCE AS TO THE CAUSE OF THE EXPLOSION. A NEAR VIEW OF THE RUPTURED PLATE.

room was crushed like an egg shell, pinning down the helpless inmates under beams and machinery, their torture being relieved only by death. To add to the horror another building containing naphtha caught fire, and in 15 minutes after the boiler exploded, a second explosion of naphtha took place, shooting hundreds of gallons of the liquid over the factory, producing an even more appalling and frightful spectacle. Another factor in the destruction was that of the water tank situated on the roof of the factory, which in falling caused the factory to collapse, thus pinning down many persons.

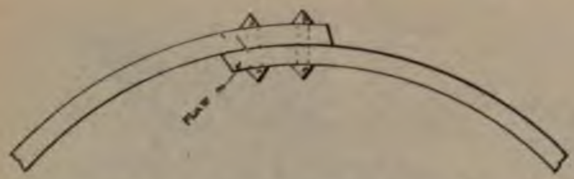


FIG. 8. SHOWING HOW IMPOSSIBLE IT WAS TO HAVE DISCOVERED THE CRACK.

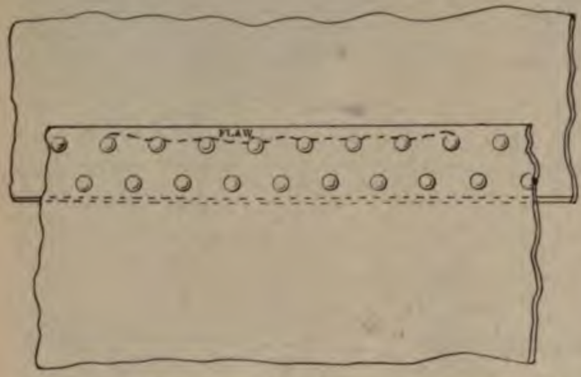


FIG. 9. DOTTED LINES SHOW CRACK EXTENDING ALONG THE RIVET HOLES ON THE UNDER SIDE OF THE OUTSIDE PLATE.

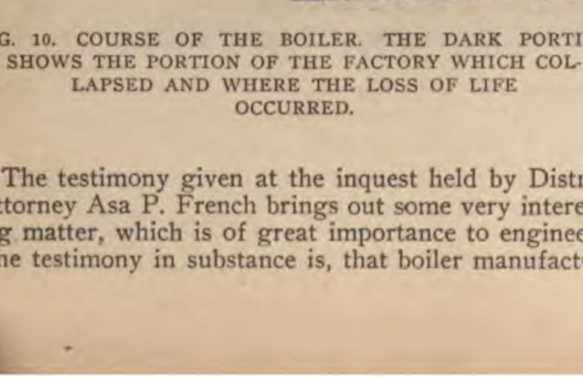


FIG. 10. COURSE OF THE BOILER. THE DARK PORTION SHOWS THE PORTION OF THE FACTORY WHICH COLLAPSED AND WHERE THE LOSS OF LIFE OCCURRED.

The testimony given at the inquest held by District Attorney Asa P. French brings out some very interesting matter, which is of great importance to engineers. The testimony in substance is, that boiler manufacturers, inspectors and engineers agree that the lap joint type, the kind of boiler used in this factory, is unsafe; this statement was made again and again. In the verdict which was reached District Attorney French is quoted as saying: "It seems to me it was due to a danger peculiar to this type of boiler, a structural danger such as the experts have described. If any one is morally responsible it would seem to be the man who devised this particular style of boiler."

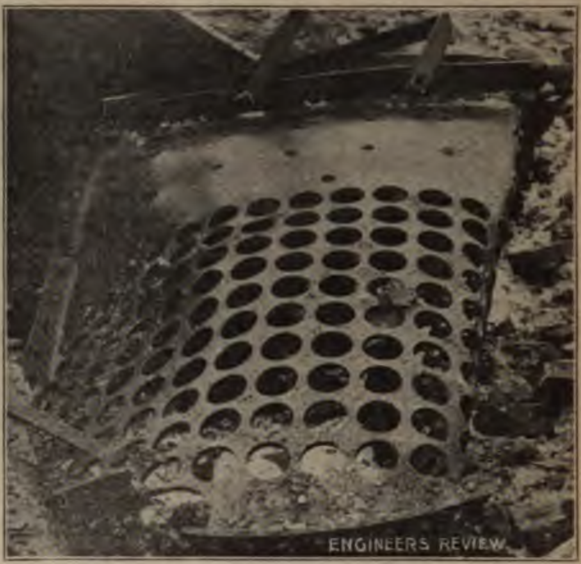


FIG. 11. ANOTHER VIEW OF THE REAR HEAD.

The testimony given by Edward Kendall, the gray-haired boiler manufacturer who made the Grover boiler, was to the effect that his firm had not made such a boiler for 8 or 10 years, and that the boiler was made of steel with a lap joint. In examination he had found evidence of a crack in the under side of the upper lap which was hidden by the inside of the lower lap of the seam, as it was between the outside edge of the plate and the rivet. Fig. 7 shows an expert making an examination of the ruptured plate.

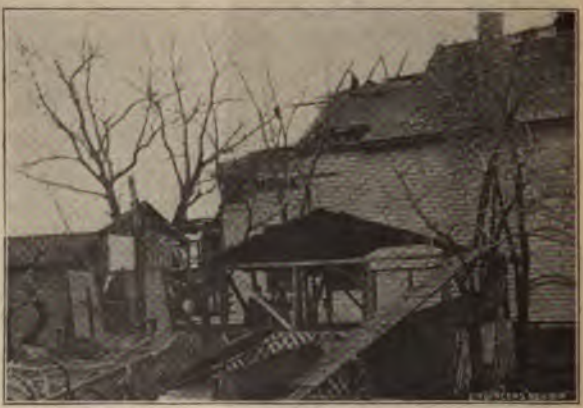


FIG. 12. ENGINEER ROCKWELL'S HOUSE SHOWING ROOF DEMOLISHED BY THE BOILER IN ITS FLIGHT.

The boiler inspector for the Hartford Steam Boiler Inspection & Insurance Co., W. W. Preston, testified that he inspected the boiler February 24, giving it an external inspection, while the inspection of December 28 was an internal inspection. He failed to present any reports stating the condition of the boiler at that time. His opinion as well as that of other boiler experts was that the lapped seam boiler is going out of use and deservedly so, because of the high pressures demanded of them, and that they are not considered the safest type of boiler. It seemed to be the general opinion that cracks like the one which caused the explosion are apt to take place after comparatively short service, although it may be years before they are known to exist.

If the investigation has proved anything, it has proved that the thousands of boilers of this type now in use in the State of Massachusetts and elsewhere are dangerous and that the only types of boiler of the return tubular design which may be termed safe are those having butt or strap seams. It is evident that as each year passes these boilers become more dangerous. If it were possible, laws should be passed preventing the use of this type of boiler especially in manufacturing localities where there is a liability of such a fearful loss of life.

No evidence was presented at the inquest tending to show that any person or persons were criminally liable, but, as said before, it emphasizes the fact that the explosion was due to a danger peculiar to the lap joint type of boiler in which a structural danger such as has been described and a danger that is common to this type of boiler, was the cause. It is a danger most difficult to detect and therefore all the more dangerous. The inquest also proved that the hints and insinuations which have appeared against the dead engineer, David W. Rockwell, are unfounded.

REPRESENTATIVE MEN FROM THE ENGINE ROOM.

The subject of this sketch, Mr. James Sumner Fitts, can well be termed a representative man from the engine room. Mr. Fitts was born at Seekonk, Rhode Island, March 11, 1856.

At an early age he was compelled to support himself; this he did by doing chores around a farm, which made it necessary for him to attend evening school in order to educate himself.

Mr. Fitts in this way fitted himself for the Polytechnical School of Worcester, Mass., entering the school when 16 years of age.

After working his way through this school he entered the employ of the Rhode Island Locomotive works, where he learned the machinist trade which has been a great benefit to him during the years he has been a steam engineer. After staying with this firm three years, he entered the employ of the Boston & Providence Railroad where he remained for a period of five years.

He relinquished this position to go with the George H. Corliss Co. as their chief engineer, running their large shop engine. After serving in this capacity for six years he went out as an erecting engineer for the same concern, and during the time he followed this line of work he superintended the erection of some of the largest steam plants in this country. After a time he was requested to come to New Bedford, Mass., by the management of the Wamsutta Mills on a job that would require about ten days' work. This happened something like eleven years ago, but Mr. Fitts is still in their employ holding the position of chief engineer. The plant, five mills, represents the largest combined plant in this section of the country.

While a practical up-to-date steam engineer Mr. Fitts can truthfully be called a self made man, and is an acknowledged leader among the engineers of this city.

He is one of the past presidents of Massachusetts No. 7 N. A. S. E. and was its first president after the association was reorganized, and has now held the office of recording secretary for several years. Mr. Fitts is much interested in the educational features of the association, is a man of sterling qualities, and with such a record behind him should be a shining example for young engineers who are seeking to reach the top rung of the ladder.

JAMES SUMNER FITTS.

Helping Themselves.

Acting on the old saying that "God helps those who help themselves," farmers around Monroe, Mich., have been loading their wagons with coal from the cars of the Detroit, Monroe & Toledo electric railroad. Having no other place, the road is nightly filled with loaded cars of coal. The farmers rejoiced over the prospect of cheap coal all the winter, but the railroad is making some investigations, and the way they quote the old saying is "God help those who help themselves, if we catch them." — *Exchange.*

THE IDEA·EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

Removing a Broken Follower Bolt.

Editor of the Engineers' Review:

A few days ago after taking the piston head out of my engine, I broke one of the follower bolts while tightening it up, but an examination showed it had been cracked part way through at some previous time. The difficulty of getting the screwed part which came just flush with the piston head, out, arose.

I decided the best and in fact about the only way in which the bolt could be got out was to cut a slot in the end similar to that found in screw heads. Then I got a piece of ½-inch iron bar about 2 inches wide, and had it bent as shown at *E*, and a hole drilled in each end; one for the stud bolt, the other being tapped for a bolt having a slot in the end. A piece of steel was obtained and made like a screwdriver at both ends, being long enough to reach from the broken bolt to the screw in the knee, which was screwed up as far as it would go and the end of the screwdriver held in place by means of a piece of tape. When all was ready, a wrench was put on the center of the screwdriver and turned so as to screw the broken bolt out and at the same time screw out the bolt, as the screwdriver fitted in the slot. I consider this a very good way to remove such difficult screws.

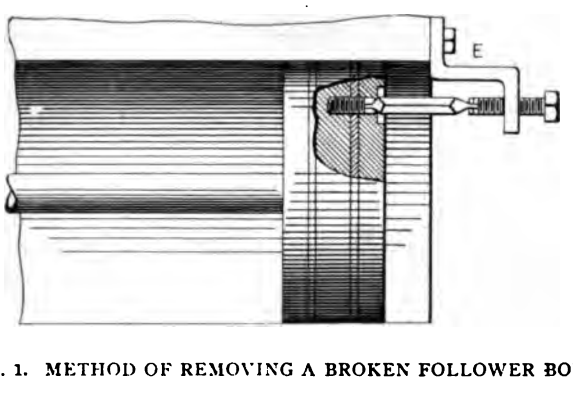


FIG. 1. METHOD OF REMOVING A BROKEN FOLLOWER BOLT.

Wanting to speed up one of our engines about 10 revolutions, and not caring to wait until a new pulley could be obtained, I decided to lag the old pulley on the governor spindle with leather, as I figured that a pulley ½-inch larger would give the desired speed to the engine and at the same time keep the governor revolving at the right speed.

To do this I got a piece of ¼-inch belt and shaved the ends down after cutting the piece 3 inches longer than the length necessary to lap around the face of the pulley. By shaving each end of the leather 1½-inches from the end on a bevel, the lagging was made to lap around the pulley smooth and without a lump at the joint. The lagging was then glued to the face of the pulley and the two ends together. To make sure the lagging would not slip, two holes were drilled and tapped for two flat-headed machine screws which were screwed in through the lagging after the holes had been countersunk so the governor belt would not cut on them. The screws on the underside of the pulley rim were headed over and so prevented from working out. The pulley and the way the lagging is put on is shown in Fig. 2.

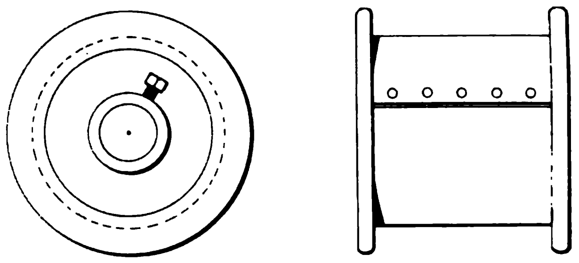


FIG. 2. LAGGED PULLEY.

When the engine was started up everything worked as expected, and we saved the expense of a new pulley, besides getting the additional speed out of the engine.

A. B. Askers.

A Misunderstanding of Things.

Editor of the Engineers' Review:

There is an old saying, "What strange things we see when we don't have a gun." This was brought to mind by a newspaper account of a boiler explosion which occurred a few weeks ago. The reporter started out by saying that it was one of the worst disasters which occurred in that section of the country for many years and stated that a 24-horsepower "engine" was the cause of the disaster, and that the building where this "boiler" was located was totally destroyed. He also states that the "explosion was thought to have been caused by cold water being put in the boiler when the boiler was quite hot, as the safety valve did not blow out the engine." It was claimed that as water from the bank had been used for the engine, that "sediment from the water had so covered the safety valve that the pressure failed to blow it out."

I don't know exactly what the reporter had in mind from the above. Of course if the engine exploded, that settled it, but if it was the boiler it was a horse of another color, but it would seem advisable for newspaper reporters to either study up on the question of engineering, or let someone report the matter who can tell the difference between a boiler and an engine explosion. According to the reporter's version of the affair, the theory that putting cold water into a hot boiler will not explode it is knocked out entirely, because he explicitly states that those in a position to know thought that the cold water was at the root of the trouble. I am glad to know that the safety valve did not "blow out the engine" because such an occurrence would have been disastrous without doubt, although just what bearing it has upon the matter, I don't know.

There is one thing evident and it is this: the users of steam boilers around in that vicinity had better not use water from the bank if there is enough sediment in it to cover up the safety valve so that the pressure will not blow it out. If there was as much sediment in the boiler as all that, it is a wonder it didn't blow up before it did.

If the report were given in a way that was at all sensible, we would probably read that a boiler exploded and that the water used in the boiler was of such a nature as to cause an excessive amount of scale to accumulate in it and that the accumulation had been so extensive as to entirely stop up the blowoff pipe so that when the blowoff valve was opened the pressure in the boiler was not sufficient to blow out the mass of scale. Taking the matter all in all, leaving aside the humorous mistakes of the reporter or the showing of his ignorance, whichever it may have been, there is an object lesson in the above which emphasizes the fact that a boiler should be cleaned out at proper intervals and that the blowoff valve should not be neglected.

Another version of the affair in another paper shows more common sense when it says that the boiler house, which was a temporary structure, was housing an old boiler which had been used before the shaft was being sunk and that it was doing temporary duty until the new boiler which was on the grounds could be put in place. The probability is that it is a case of an old boiler being forced to work with a pressure which should not be carried in anything but a new boiler, and that the explosion was simply caused by natural results, that is, the boiler was not strong enough to stand a pressure of 90 to 100 pounds.

Wiper.

Homemade Lubricator Attachment.

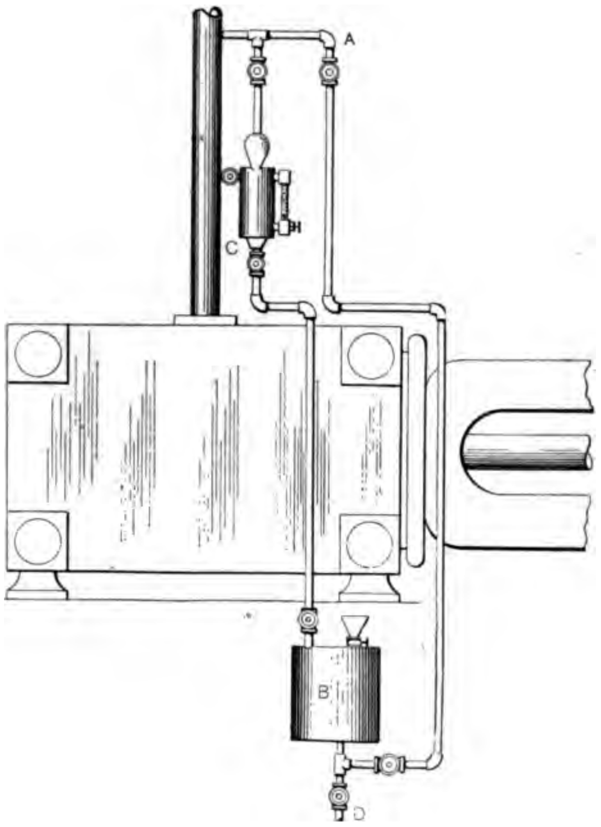
Editor of the Engineers' Review:

I have been much interested in the Idea Exchange and have read it each month with both pleasure and profit until at last it occurred to me that I was reaping a considerable benefit from the ideas and experiences of others without contributing anything for the common good. So I will now try and help along with a trifle or two.

In a former issue "A. Loafer" gives a sketch of an arrangement for using a hand oil pump as a lubricator filler, and among other claims for it says it does away with the spilled water in emptying the lubricator reservoir. It occurs to me that the water of condensation will have to be disposed of in some way before he can pump oil into the lubricator, as I can't figure out how he is going to displace this water with the oil from the pumps except in the usual way. Perhaps he can enlighten us on the subject.

The following sketch and text will explain my lubricator kink and it is homemade, too, out of such materials as one can always find lying around with the possible exception of the valves. I have found this scheme to save quite a quantity of oil in the course of a month; more especially on the pumps, as one will almost invariably find small lubricators on them. As they have to be filled quite often, a good deal of oil is spilled unavoidably. However, this outfit works equally well on large and small engines, pumps, or on both in any combination you choose.

I make a tank of suitable size, (I use one holding 5 gallons) out of a short length of pipe of large diameter with the ends capped, or with flanges turned to fit, and riveted and calked like a boiler head. This I place in any convenient place, in my case under the cylinder as at *B* in the sketch. I run the steam pipe *A* to the bottom of the tank *B*, providing valves to shut off steam and also to drain through the valve *D* when filling.



LUBRICATOR AND ATTACHMENTS.

From the top of *B* the pipe *C* is connected to the bottom of an ordinary lubricator and is attached where the drain plug is ordinarily placed. The sight feed glass on the lubricators is used as it was before, *i. e.*, to control the supply to the cylinders. A short nipple with valve and funnel as shown is provided for filling the tank *B*. This outfit can be used for one or half a dozen engines or pumps by carrying an oil supply pipe to the lubricators on each in the manner shown. When your tank is practically empty of oil you can shut off the valve controlling the supply to the lubricator and they being full, will supply the cylinders while you refill the tank. The small amount of water accumulating in them will find its way to the tank when you again open communication between them.

W. Y. Oming.

Exhaust Steam for Heating.

Editor of the Engineers' Review:

I see that Mr. Naylor and others have written their views on the question of heating by live steam and hot air, as well as exhaust steam. Mr. Naylor thinks that the hot air system is the best and most economical, and while I do not care to dispute his statement, as he doubtless has tried other methods of heating, I wish to present a few facts relating to heating by exhaust steam.

In the majority of steam plants operating in manufacturing plants as well as in office and power blocks, the simple noncondensing engine is used which delivers some 10 per cent of the heat of the steam in the form of power and wastes the remaining 90 per cent in the form of exhaust steam.

Anything that can be saved is of value and this has been demonstrated in all of the great industries of the country and is exemplified in a very striking manner by the methods used by some of the great packing houses of the West, where nothing is allowed to go to waste, but all the by-products are saved and utilized for some purpose. The exhaust steam from a noncondensing engine is a by-product which can be utilized for some purpose or other.

In every plant where the manager has a particle of wisdom, something of this by-product is saved by using a feedwater heater. By this process it is safe to say that another 10 per cent of the heat delivered by the boiler is utilized, which leaves a valuable by-product of fully 80 per cent to be thrown away and wasted, and in this waste we see what represents a large portion of the operating expenses. If some operators of steam plants could be made to see and realize just how much money they have thrown away in the last 10 years, they would be candidates for an asylum.

Not only is the steam allowed to go to waste, but nearly all of the water evaporated is also thrown away, which must be replaced by fresh water. If this could be alleviated the expense of feedwater would be reduced and the trouble with dirty boilers would be avoided.

In order to heat by exhaust steam it must be conducted rapidly through the pipes which are insulated to prevent radiation where heat is not required and not insulated in the portions of the building requiring heat. Exhaust steam should also be used without placing any back pressure against the engine, because every fraction of a pound of back pressure is a serious detriment to the efficiency of a steam plant and it detracts from the load carrying capacity of the engine. It is said that every 5 pounds of back pressure means that 1-7 of the engine power is thrown away. When exhaust steam heating is employed the system must be so arranged that the heat circulation may be under absolute control in order to supply a suitable heat for varying temperatures; therefore regulation and ability to furnish a mild heat in ordinary weather and an extra amount in very severe weather is a very important feature.

There are several ways of arranging exhaust steam heating systems. One is to deliver direct to the main steam pipe, driving the steam through the pipes by carrying a back pressure against the engine furnishing the exhaust. With this system all the condensation is lost, together with the heat in the condensed steam which is something like 140 degrees, in most cases. Then again, all condensation of any live steam that may be used at times when there is an insufficiency of exhaust is also thrown away which makes another important loss.

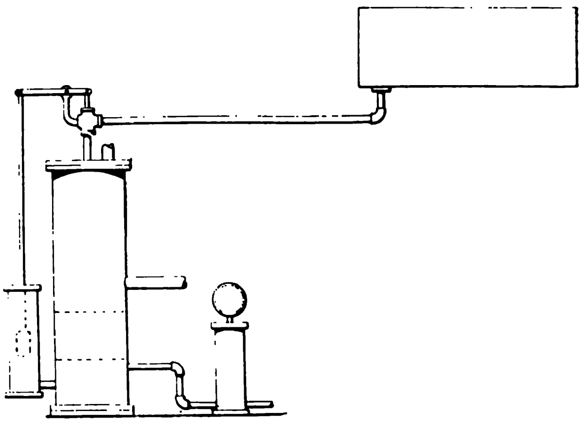
Of course there are cases where this water of condensation is caught in traps and returned to the boiler, but there is the accompanying danger from oil with the serious results which are well known to every engineer.

When it comes to a heating system using exhaust steam it would seem that a system which requires the aid of a vacuum pump is most satisfactory and at the same time the most economical. L. M. Wentzel.

Regulating Valve.

Editor of the Engineers' Review:

The plant I am running has an open heater with an overhead tank connected to the heater by a 1-inch pipe. The water runs from the tank to the heater by gravity and was regulated by a globe valve and as my pump would vary in speed, the water would run either too fast or too slow, which was very annoying. So taking an old 1-inch angle valve I filed the thread from off the stem, so it would lift instead of turning, and by attaching a lever to the stem it would extend beyond the side of the heater. I tapped a ¾-inch hole in the heater and after making a galvanized can 5 inches in diameter and 16 inches long, I connected it to the heater by a ¾-inch pipe which gives the water level in the can as is in the heater. I then put a float in the can and ran a No. 9 wire from the float to the lever on the valve. The float closes the valves before it gets too much water, and when the water lowers a little it opens and lets the water in. The apparatus is shown in the illustration.



VALVE AS APPLIED TO THE HEATER.

Wm. Webster.

Sees Himself as Others See Him.

Editor of the Engineers' Review:

On page 29 of the March Review, F. H. wants to know what caused the bulge on the mud drum of the boilers which are under his care. In the first place I don't like the way the boilers are piped together; in fact I never had much use for a mud drum on any boiler. As to the direct cause of the bulge it would seem to be a case of lamination on the plates due to poor work in the construction in the rolling mill.

n this is the cause no amount of care on the part e engineer can prevent the plates from separating the part of the plate next to the fire bulging out. were F. H. I would drill a hole through that bulge satisfy myself as to the real condition of the plate, if the plate has blistered, have it cut out and the remedied with a patch.

last I am able to see myself as others see me. S. nith on page 29 of the March issue has presented vith a looking glass and for the first time I see lf in my true light. He says that in an emergency ıy kind I would be practically useless and of no : whatever. Perhaps Mr. Smith is right, I can't or a certainty, because I have never had what I d call an emergency, although I have worked in fairly good sized plants. In fact I never had a ıs accident in my life and don't look for one, if ınd attention can prevent it. I have always main-d that the engineer who is always having trouble his plant is either careless and neglectful, or he know his business.

.s so easy to sit down and write to the paper what vould do in case this or that happened, but it is all .yrot, because no one knows what he would do something comes up. I have seen men so rattled hey couldn't tell you their name, didn't know how got where they were, and so what is the use of ıg out in black and white and undertaking to tell one would do in case of an accident. I will ly admit that I don't know what I would do.

e thing I am pretty sure of and that is that I d certainly look out for No. 1 before I allowed ead to be split open from a fragment of a flywheel, :o be called a dum fool for my trouble, after they lanted grass seed over me.

now it would be sort of heroic to have a tomb over one's grave, made in the shape of a broken eel or having the brave engineer grasping the le wheel with a chunk of wheel rim hitting him in ead, while his knees give away and an expression face that says I die that my employer may not to buy a new engine. It would be nice to have ngineers' lodge come and bear you tenderly to st " fireroom," and to know that the funeral ex-s would be paid out of the small insurance from ssociation, but as far as I am concerned I would have the boss get a new engine and at the same ıllow me to eat three square meals a day, even if have to earn them in another place.

n afraid that Mr. Smith has been reading of the locomotive engineers who meet death with their on the trottle for the sake of the passengers in ain behind, but, brother Smith, I have railroad ience enough to know that when the engineer jump when he sees trouble ahead it is because he doesn't have time to do so, or because he thinks is a better chance of his coming out whole by g in the cab. It isn't because he wants to pose as , and I reckon the same holds good in stationary ce.

F. G. Peck.

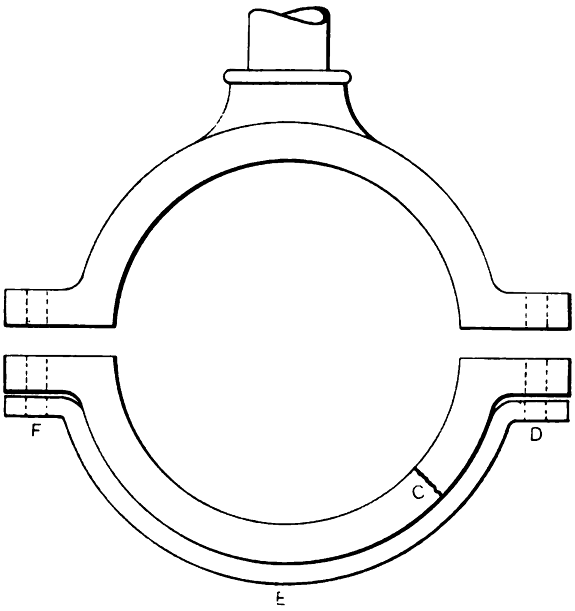
Repaired Eccentric Strap.

of the Engineers' Review:

as much interested in the letter by F. Davis in bruary issue on page 21, especially regarding the e repaired a cracked eccentric. I also think all that was said regarding the method of securing eccentricts is correct and it seems strange to me that the eccentrics are not designed in such a way as to leave a hub the same as an ordinary pulley in which to put the set screw. Of course there are some designs of engines in which this would not be practical, but in a good many it would, and the added cost of metal and labor to get an eccentric ready for an engine shaft would not be worth mentioning.

The repair of the eccentric put me in mind of an eccentric strap repair which I had occasion to make some time ago. As shown in the illustration, the crack occurred at *C*, on the right side of the outside strap and while the crack had not extended entirely through the metal when it was discovered, it was of such a nature as to make it unsafe to operate without being repaired. In this case the outside surface of the eccentric strap was nearly flat, being slightly rounded, which made the job much easier than if the strap had been ribbed.

Repair was made by bending a flat bar of iron, *D, E* and *F*, the blacksmith concaving the inner surface to fit the strap. The iron was then bent as shown, leaving a slight clearance at *D* and *F*, in order to permit the ends to be drawn up tight by the bolts. This made a repair which was nearly as efficient as the original strap and did good work until another was secured which was placed in position more as a precautionary measure than from actual necessity.



ECCENTRIC STRAP AS REINFORCED.

I heartily agree with " A. Loafer " on page 39 in regard to having enough boilers in a steam plant. I have been fortunate enough or unfortunate enough, whichever way you choose to put it, to work in a number of plants, both large and small, and I never have yet, with one exception, found a plant which had sufficient boiler and engine capacity. The exception was a government power plant, and I have no doubt but that it is overloaded in either the engines or boilers by this time.

I have noticed that steel plate around boiler rooms which comes in contact with coal deteriorates much faster than any other plate, and this same will be found true regarding the steel beams which support water tube boilers where they are exposed to the gases from the furnace. I do not know what the chemical action is, but I suppose it is caused by the sulphur in the coal and smoke. In our plant we have the coal bin directly in front of a battery of three boilers, with a sliding steel door which can be lowered or lifted as coal in the bin demands. When the bin is full, or nearly so, the sliding door is practically down as far as it will go, and as a consequence coal has laid against it. Chemical action took place to such an extent that the door became so thin that there was danger of its giving away, letting the whole pile out in the fireroom. The way we remedied this for the time being was to put metal strips across as braces, but the time is not far distant when a new door will have to be procured.

The same thing occurs in the hoppers of the stokers which, of course, are kept full of coal and we have noticed that the metal plates have deteriorated very fast. We found also upon examining the beams which support the boiler that they have scaled off considerable, and it is an easy matter to take a knife and in running it up the beam, scale off pieces a quarter as large as your hand and over 1-64-inch thick. I think this deterioration is caused from the sulphur in the smoke from the furnace. If other boilers are affected in the same way as ours, it seems to me it is a proposition for the manufacturers of boilers supported by metal beams to take under consideration. B. S. Drekers.

Boiler Feeding With a Trap.

Editor of the Engineers' Review:

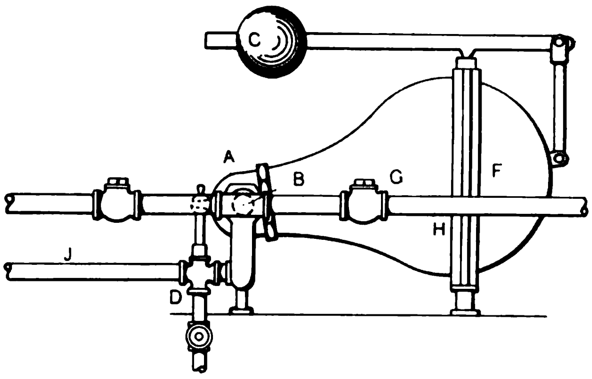
The question of boiler feeding has been taken up by the boys more or less, but I am of the opinion that there is a little more to the subject than has been brought out. While different kinds of pumps have been debated upon, and the relative merits of each upheld by the advocates of each, several points in regard to feeding a boiler have not been touched upon at all.

It seems to me that capacity and reliability are the most essential points to consider when deciding upon a boiler feeding apparatus. I have seen a few steam plants that did not operate a pump or other feeding device because the pressure in the water main was higher than the steam pressure in the boiler. This is a condition that is rather unusual, however. The general method is, as all well know, to use a feed pump of some kind, but the pump or inspirator is not absolutely necessary in order to operate a steam plant.

I stepped into a plant the other day and found the engineer had piped up a Bundy steam trap to feed his boiler with, and it was doing good work. The only thing to watch was that the check valves did not get to leaking, as that interfered in the working of the trap.

By looking at the illustration, it will be seen that the feeding is automatic as the trap will work just as long as there is water to feed into the boiler and steam to trip the trap. The construction of the trap is shown also the piping to the heater where the water was heated by the exhaust steam from the engine. Every one knows that this trap works with the bowl or receiver swinging on the trunnions *A* and *B*, and balanced by means of the weight *C;* the swinging of the receiver working the valve *D* on the steam pipe *J*. The water from the heater enters the bowl *F*, through the pipe *G*, and the hollow trunnion *B*. As soon as the water in the bowl becomes sufficient, it overbalances the weight *C*, and the bowl descends until it rests on the frame *H*. This motion causes the valve *D* to open. This allows steam to pass from the boiler to the bowl through the hollow trunnion *A*, to the upper part of the bowl by means of a curved pipe running from the trunnion to that part of the bowl on the inside.

This of course subjects the water in the bowl to the same pressure as that in the boiler, and as the trap is located on top of the boiler, the water runs into it by gravity, through the trunnion *B* and the discharge pipe extending out from the pipe *G*. When the water has been discharged, the weight *C* draws the bowl upward ready for filling again. With most traps, there is an escape pipe for the steam that is left in the trap after discharging the water to the boiler, and this valve is opened when the trap returns to the filling position. In the case that I saw, however, the engineer said that he did not allow the steam to escape into the air as there was no need of doing so, because the incoming water condensed the steam as soon as it got into the receiver on the bowl.



BOILER FEEDING WITH A TRAP.

It will be seen by the sketch that the feed and discharge pipes are provided with a check valve each. They are to prevent the return of the water to the heater when the bowl receives steam from the boiler, and to keep the water in the boiler while the trap is filling.

This trap was fed by water from the town water main which was about 65 pounds pressure. It did away with a pump, or rather the operating of a pump, and the waste of steam that goes with it, as the water flowed to the trap through the heater, and entered the boiler at a temperature higher than it would if the pump had been used. This is quite evident when it is seen that the steam used for operating the trap is condensed and returned to the boiler again without loss, as the heat is given to the ingoing feedwater.

I hardly think that the idea would work in a plant where the boiler was doing hard work, but in plants of one boiler and a light load, it seems to me that the scheme might be worked in a successful manner.

I. J. Manley.

Shaking Grates.

Editor of the Engineers' Review:

When we sit down and read the letters that appear in the different engineering journals we often run across some queer statements or at least those which appear to the reader that way, and often a sober consideration of the matter fails to bring any enlightenment as to the meaning of the author. Such an instance occurs in the letter by Chas. Yacky on page 12 of the January issue. In his statement regarding shaking grates he says that he believes the less the shaking grate is used, the better off one is, and that by using a slice bar less ashes are made.

I have tried to reconcile this statement with actual practice and have failed. I have had some experience with shaking grates and up to the present time I have not been able to see wherein they are an ash producer. I fail to see how the burning of a particular grade of coal can make any difference as to the amount of ash no matter what kind of a grate it is burned upon as long as it is not proportioned so as to allow particles of coal to fall through and mingle with the ash. This of course would be a waste, but with the proper working of the shaking grate there is little need of doing this. If a man does not know how to use a shaking grate of course he can bring about a waste of fuel, but as to an increase in the ash accumulation, I cannot see how this can be brought about. I should consider it a piece of folly to have a good shaking grate under a boiler and then discard it using the old-fashioned slice bar, which not only causes more work to the fireman, but does not allow of such a thorough cleaning of ashes from the grates.

I have an idea that Mr. Yacky has not been using his shaking grates as they were intended and perhaps it will not be out of place to tell the readers of the Review how I use this type of grate. When I start in the morning the fires are raked out as with any ordinary grate, having been banked in the ordinary way over night. The fires are allowed to burn until no reflection of the live coal shows down through the grates, when the bar is put in place and the grates shaken until the first live sparks fall through into the water in the ashpit. That is all there is to it. There would be a waste of coal undoubtedly if the operation of shaking was continued until quantities of live coal came through the grates. This, however, is not at all necessary as all that is wanted is to clear the grates of ash.

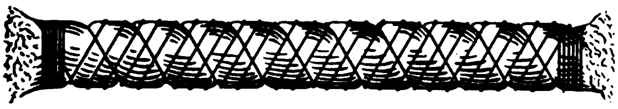


FIG. 1. ROPE SWAB.

I am in favor of water in the ashpit for the reason that it prevents the clinker forming into a solid mass on the grate, and if any one is troubled with this he will find relief by the use of water.

As most every one in their letters winds up by giving one or two kinks which they use around their engine room I will do the same. Some years ago I got the idea from somebody or somewhere of making a swab such as shown in Fig. 1. It took a little experimenting, however, for me to find out all the particulars regarding it. The original information was to get a piece of rope about 1-inch in diameter and after tying one end cut off a piece about 6 or 8 inches long and then tie the other end to prevent unraveling. Nothing was said, however, about the kind of rope to use and that is where the trouble came in. I first got a piece of ordinary Manila rope, but I found that it was more like wire brush than anything else and failed to act as a good soft polishing swab. After a few trials I discovered that such a swab could be made from ordinary cotton clothes line, taking about five lengths, unbraiding them and then twisting all the strands together, wrapping as shown. This made a good soft swab and one that operated very satisfactorily.

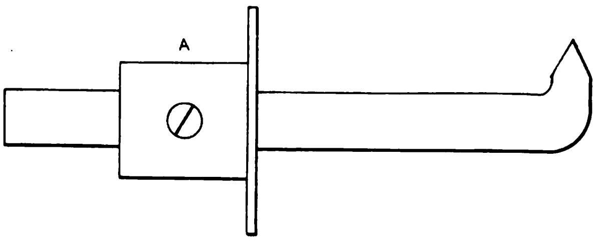


FIG. 2. WATER GLASS CUTTER.

Another little device, which I made is for cutting off gage glasses. I have tried the old scheme of wrapping a string around the glass after soaking in kerosene and then setting fire to the string and putting the end of the glass into a pail of water, trusting to luck that it might crack off where desired. As a rule, however, it did not crack anywhere near where wanted. Then there was another method of taking a match and after wetting the brimstone end, scratch around on the inside of the glass where it is desired to cut it and then apply a lighted match to the outside. Sometimes this would work and sometimes it wouldn't.

The little article in Fig. 2, is nothing more than a piece of round ¼-inch tool steel bent and brought to a sharp point as shown, and then tempered in oil. A gage collar was made as shown at *A*, having a projection at one end to more than cover the end of the glass. The gage is held in place by the screw. The glass is, say ½-inch longer than is required. The gage *A* is slipped up on the cutter until it is just ½-inch from the cutting point, then by turning the instrument around on the glass, it will be found to act nearly as good as a first class diamond.

Edward C. Kennedy.

Something About Pumps.

Editor of the Engineers' Review:

Although considerable has been written in the Review recently regarding pumps and their troubles, there still remain a few points which have not been touched upon that I am aware of. There is one thing regarding setting of boiler feed pumps that is usually omitted and that is regarding the height from the floor. As a rule they are set either on the floor of the engine or boiler room, or in other instances on a foundation which comes a few inches above the floor. In my opinion the pump should be placed on a brick foundation, high enough to be comfortable to the man in charge, so that they will be in a position for easy repairing and overhauling when necessary. Every engineer will admit that it is very little amusement for one to try to stand on his head while trying to see the inside of a cylinder, which is practically what he has to do when the pumps are located on the floor. I have kept this in mind when having occasion to place a new pump and have always seen to it that the foundation was built high enough so that a man's head would come about level with the pump cylinder if he were kneeling down.

Another thing I have noticed is, that there is usually considerable drip from the stuffingbox and sometimes from the cylinder pet-cocks, which makes a sloppy, nasty mess around the pump and foundation. In several instances I have adopted the following with excellent results. I have a galvanized iron pan made as shown in section in Fig. 1, the section, however, being exaggerated in order to give a clear idea of the shape of the pan. As the pan has a lip all around, it is impossible, of course, for the water to overflow unless the drain pipe becomes clogged.

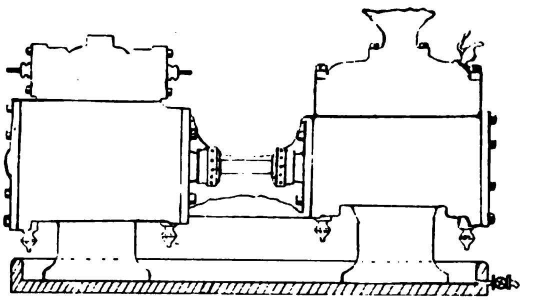


FIG. 1. DRIP PAN FOR PUMP.

The holes for the anchor bolts are made a snug fit and rubber washers placed over the anchor bolts between the pan and the pump legs. Then when the nuts are screwed down on the bolts the rubber rings act as packing and make a water tight joint around the bolts. At one end a drain pipe is soldered in as shown which is connected to a waste pipe and allowed to run outside of the building. As the pan is placed in a position so as to be lower at the left hand end, the water drains out at once and the annoyance of having a wet and filthy foundation is done away with.

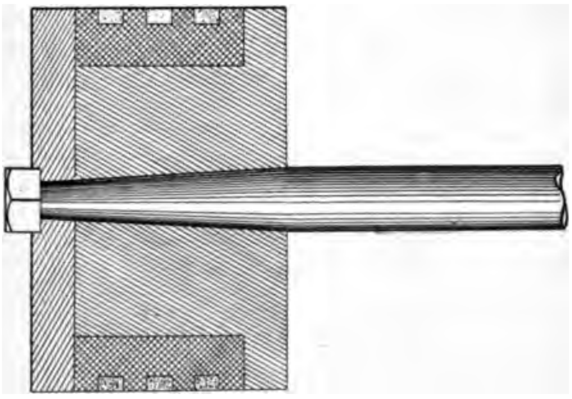


FIG. 2. BABBITT BUSHING FOR PACKING.

Another little trouble I had with a pump may be worth the reading at least, also the way in which a remedy was found. In this case the pump was a boiler feed having a square water packing. This packing would not last any length of time and gave considerable trouble. When the pump was opened particles of packing would be found obstructing the discharge valves. In order to do away with this I cast a babbitt ring around the spider and turned the babbitt to fit the water cylinder. Three grooves were also turned in the ring just ½-inch square to receive the half-inch square hard fibre packing which was forced into these grooves tight. By doing this I found that my troubles had disappeared and I had no more packing lodging in the discharge valves. Fig. 2 shows how the job was done.

The recent letter by W. Deming discussing lubricators *vs.* force feed pumps was interesting. In my experience, I have never had any particular difficulties with the way my lubricators have worked, nothing occurring out of the ordinary more than might be expected. I have also had my ups and downs with the force feed pump, but on the whole I find that they give good satisfaction and can be relied upon.

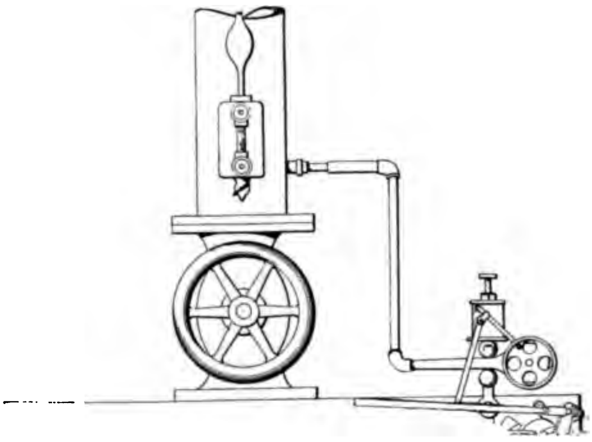


FIG. 3. LUBRICATOR AND OIL PUMP AS CONNECTED.

In my own plant I have both the force feed pump and the lubricator attached to the same engine. When I came to the plant I found that the oil pump was being operated while the lubricator was hid away in the corner of the cupboard where it remained until one day the force feed pump became clogged up for some reason or other when I found I had no way of getting oil into the cylinder. Happily the trouble was overcome in a short time before any damage was done to the cylinder or the engine. It taught me a lesson, however, that two ways of doing a thing are better than one when it comes to a cylinder lubrication, therefore I connected up the lubricator as in the ordinary case and the force feed as shown in the illustration, Fig. 3, which had before discharged into the lower connection formerly used by the lubricator. In this way I could operate either the lubricator or the oil pump or both if desired, and from that time on felt secure against any interruption of the proper lubrication of the cylinder.
A. E. Akers.

Pressure on Valve Disks.

Editor of the Engineers' Review:

In reading a recent number of the Review I came across the statement made by R. D. that he thought if the valves had pressure under the disk instead of above, it would remedy to a great extent that troublesome feature of scale settling upon the valve seat of the blowoff valve. He further asks for readers to give reasons why the blowoff valve should have the pressure above the seat. As no one has up to this time answered the question, I thought perhaps a few words on the subject might not come amiss.

I have never been able to determine a reason that would cause anyone to decide upon putting a blowoff valve or any other valve in a steam line, having the pressure come above the disk and the only reason I have ever heard as an argument in favor of such a procedure was that in case the valve disk became disengaged from the valve stem it would fall off, and in all probability close the valve, which according to the opinions of those favoring this method is just what is required. I can cite instances where an occurrence of this kind would not only have caused inconvenience but would have shut down five dynamos in so doing.

In the instance referred to it was the throttle valve of an Armington & Sims high speed engine to which were belted five arc light dynamos, three machines being belted from one flywheel, while two were belted to the wheel containing the governor. In this instance the disk of the throttle valve worked loose and fell down into the steam chest where it snuggled up in one corner and did no damage to the piston valve. It was not known that the disk had worked loose until an attempt was made to stop the engine in the morning, when the trouble was discovered. The engine was shut down by means of a stop valve in the steam line.

Here is an instance where if the steam had been coming against the valve disk, the probabilities are that the steam pressure from the boiler would have forced the disk against the valve opening in such a manner as to partly if not wholly shut off the steam which would have put out 200 arc lights.

For my part I believe the common sense way to place a valve in a steam line is to have the pressure come below the valve disk. There are several reasons for this which to me are important ones. The main reason is that the valve stem can be packed in case of leakage at any and all times without cutting off the whole line of steam piping, and this I have found a convenience in a good many instances. Another reason is the fact that when the valve is closed there is no pressure upon the packing around the valve stem, and it therefore lasts longer. I do not take much stock in the assertion that there is less pressure upon the valve cap when the steam comes under the disk than when it is on top because it stands to reason that there must be as much pressure on the valve cap due to the stress on the valve stem screw in keeping the valve disk in place against the pressure under the disk, as there would be from the steam itself. In all probability there is a little more, although it might be in favor of the steam pressure if the matter was figured on a scientific basis, because there would be less area for the steam to work against when coming against the valve disk than when exerting its pressure against the valve cap.

The letter by W. H. Bechtold on page 16 of the February issue relative to the thump which a certain engine had, the cause of which was finally located in the key in the flywheel brings to mind one or two instances which have happened in my experience.

One of the first Corliss engines that I was fortunate enough to operate was a Sioux City, and a better engine I never want to run, but it had a sharp thump and click at each revolution. We keyed up the pillow block, the outboard bearing, crankpin brasses, crosshead, crosshead shoes, and about everything else we could think of. One Sunday we concluded to give the engine a thorough overhauling and see if it were not possible to locate the sound. As we had already gone over the bearings, etc., we started in this time with the flywheel, starting first with the nuts and bolts which were put through the rim where the wheel was joined, but these were found as tight as it were possible to make them. The hub bolts, however, we found were loose and after tightening them up as tight as we could with a wrench made for that purpose and about 6 feet of 2½ inch pipe on the handle, we found that when we started up the click had practically disappeared, although there was a slight sound. We knew, however, we were on the right track and that eventually we would be able to remove it entirely.

E. F. Wettstein.

Putting Water into a Hot Boiler.

Editor of the Engineers' Review:

Although many think differently as to the effect of putting cold water into a hot boiler, I know it is a dangerous practice. I know of a case where the water was allowed to fall below the water line, while the boiler was in operation, and afterwards pumped up to two gages, with no serious trouble just at that time, but later on the boilers were consigned to the old iron pile on account of this one cause. When it comes to heating a boiler red hot, and then introducing cold water, I think the idea absurd. I must say that I cannot believe that the firebox of the 10-horsepower boiler was heated red hot when the water was introduced, or there would have been something doing just at that particular time, as has been stated by one of your readers.

If anyone has doubts just try a little experiment for himself, and I think that possibly he may change his mind. Just pour a little water on a red hot stove and notice the immense volume of steam it will make, or heat a medium-sized iron bar and plunge it in a tub of water and just notice the explosion that takes place.

Should the water introduced to the red hot boiler not cause an explosion, the heat alone would destroy the tensile strength of the boiler.

C. J. P.

Keeping Up Steam Over Night.

Editor of the Engineers' Review:

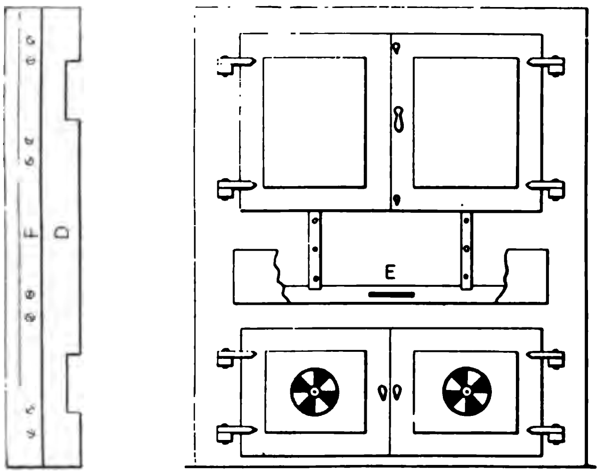
It is no uncommon thing to go into a fire room and in conversation with the engineer have him state that he finds it an impossibility to keep any steam over night, and he can't explain the reason why. His next door neighbor has no trouble, and has plenty of steam when he gets around in the morning.

Now, if one boiler will keep up steam all night with a banked fire, another boiler ought to do the same, and if it does not there is a good and sufficient reason. In one steam plant it may be that there are valves on one or more steam lines which have become so worn that they will allow all the steam in the boiler to leak as well as what steam may form during the night. A good evidence of this is the fact that the pipes will be nearly full of water the next morning and the water in the glass down to the bottom gage. When this is the case, it is an easy matter to prevent the leak and at the same time have plenty of steam in the morning.

Another cause is the way the boiler setting has been built. If the walls of the building and the side wall or walls are one and the same, it will be found that the temperature of the furnace will be influenced to a considerable extent, and more so in the winter months. This is because the cold has direct communication with the boiler setting, and therefore has no protection against zero weather. When a boiler is so placed, the engineer has little or no remedy for preventing the loss of steam over night.

Another cause is allowing cold air to enter the boiler furnace while the fires are banked. This is a practice which is indulged in more than is generally supposed, and is a practice which will eventually lead to leaky tubes in the rear head if not leaky seams, or perhaps both.

This letting in of cold air will be found principally in plants having some kinds of mechanical stokers, when the fires are banked. In fact, some makers of mechanical stokers claim that the air let in through their device will do no harm to a boiler, but it is evident that boilers equipped with these kinds of stokers will not hold their steam over night and the reason has been proven without doubt that it is due to the cold air which is drawn in through the furnace.



DEVICE FOR STOPPING UP THROAT OF STOKER.

I know of a case where a boiler was equipped with a Brightman stoker. The engineer found it impossible to keep any steam over night and could not understand why. Here is the reason: When the fires were banked for the night, a space the length of the stoker and about 5 inches wide was left for the cold air to draw into the furnace, and as the stack had no damper in it there was about a 20-mile breeze going up under the boiler all night. Is it any wonder the boiler did not hold steam?

In another plant the boiler was equipped with a Brightman stoker and the engineer had trouble in keeping up steam over night. The tubes in the rear head also gave more or less trouble through leaking. This state of affairs had evidently been going on for some time, as the engineer upon taking charge of the plant found the tubes caked with magnesia, etc. The tubes were rolled, and a device made as shown in the illustration at *D*. It is nothing more than a piece of thin sheet galvanized iron cut of a sufficient size to fit over the opening or throat of the stoker to prevent the air from rushing into the furnace all night. It is stiffened by a strip of thin wood about one inch wide and ¼-inch thick running lengthwise as at *F*. The manner in which the opening is covered over is shown at *E*. Since this idea has been in operation there has been plenty of steam in the morning, and it has taken less coal to get up steam, because practically no coal is used in getting the steam up to working pressure. In fact, before the fire is in condition to carry the load, the boiler will be blowing off. A Loafer.

Noises in Steam Plants.

Editor of the Engineers' Review:

I presume it is a well known fact that some steam plants are operated in a far more noiseless manner than others. In some plants it cannot be helped, and in others it can. One of the greatest, or perhaps it would be better to say the only objection engineers have to the engine having dashpots for closing their steam valves is the continual swish, swish of the dashpots twice every revolution. This is one of the noises which can be avoided in case the engine has not been equipped with what is known as the noiseless dashpot. In my plant I had a set of dashpots which made a most disagreeable noise, and I determined to get rid of it if I could. I therefore piped the dashpots as shown in Fig. 1, so that the pipes ran down through the floor and under ground, ended in a pit away from the engine room, and that noise bothered me no more.

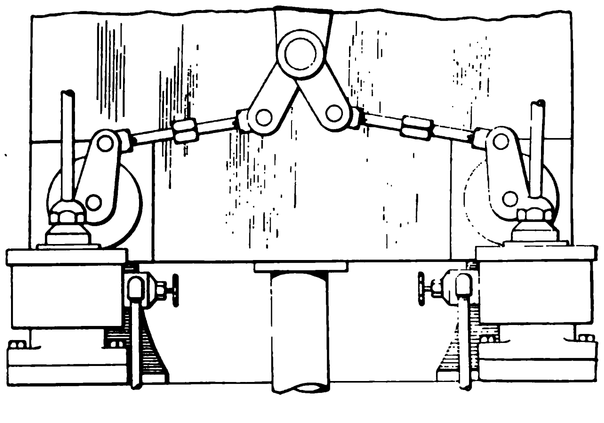


FIG. 1. DASHPOTS PIPED BELOW THE FLOOR.

Another noise was caused by the valve stem hole in the bonnet *B*, Fig. 2, being bored too large, which allowed the stem to lift every time it was engaged to the hook block, and when the block let go there was a clicking noise that was somewhat disagreeable. In order to stop this, I removed the bonnet and had the hole bored out larger and bushed down to the proper size. This not only stopped the noise, but removed a tendency of the valve stem to break because of the strain put upon it.

In another case, the noise was with a duplex pump. Every time one side moved from one end of the cylinder to the other, there was a click, which was located

in a loose key as shown at *L*, Fig. 3. Another key was made of soft steel and driven in place, and another noise was stopped.

I was much interested in R. W. Turner's letter about scale, in a late issue, and it strikes me that the idea advanced is that something is wanted, not to eat off the scale from the boiler shell, but something which will "cause the scale to decay or crumble to pieces so that it can be washed out, when the boiler is blown off."

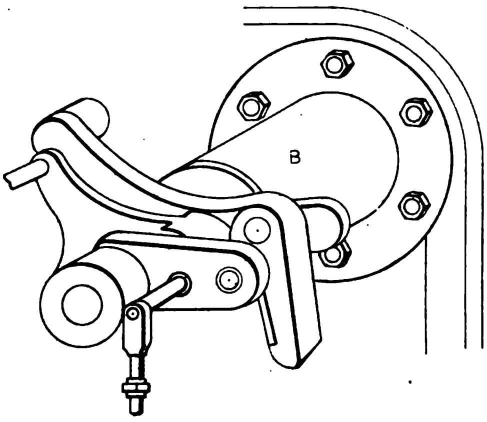


FIG. 2. BUSHED BONNET.

I don't know whether Mr. Turner is onto such a compound or not, but if he wants to know of it, just drop me a line and I will put him next.

As to the question brought up by R. D. on page 20 of the same issue, I think it is the best policy to have the pressure come upon the under side of the disk rather than on the upper side. My reason for this is because it does not bring the pressure on the stuffing-box on the valve, and therefore the stem does not get **to leaking. Another thing, if the stem does get to leaking, the valve can be closed and the stem packed while steam is on the pipes; that cannot be done if the pressure comes on the top of the disk with most valves. As for the disk coming off, I don't think it makes much difference whether the pressure is above or below. It might come in handy one way, and be equally as convenient in the other.**

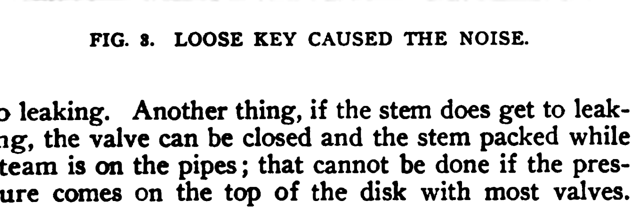


FIG. 3. LOOSE KEY CAUSED THE NOISE.

I had to smile a little as I read the paragraph of R. E. Bel telling Mr. Stokes how to stop leaks in an easier way than by using pipe clamps. His method is of course the best, but it isn't always possible for an engineer to shut down a steam plant every time he has anything come up for repairs. The owners of the business have a little to say, and as a general thing they demand that the plant be kept going as long as it is possible, even if the steam pipe does leak. If it is not possible to stop and make repairs what is the next best thing to be done? Why, stop the leak the next best way and it seems that that is what Mr. Stokes did. H. Teeman.

Comments on a Few Letters

Editor of the Engineers' Review:

As I have nothing lengthy enough on one particular subject to write of, perhaps a few comments on some of the letters in the January Review will not be out of place.

The separator by J. Wight is all right for a home-made device, but I should like to know what he does with the water he drains off. I am under the impression he lets it go to waste, while it would be a considerable saving to return it to the boilers. The water is the same temperature as the steam and all it requires is reevaporation. The heat required to raise that amount of water from the temperature of the feed-water to the temperature of the water or steam in the boiler would be saved.

W. Deming describes a lot of lubricator troubles which I have had the good fortune to miss, but may encounter all too soon. I don't know what he means when he says: "Another kind works good until the oil is nearly fed out, when the lubricator will stop feeding, as the condensation in the reservoir is equal to the quantity in the condenser." Most of my experience has been with the Detroit sight feed lubricator and they work well until empty of oil and the quantity of water in the reservoir is several times the quantity in the condenser. I do not see that the relative quantity of water in the two places has anything to do with the feeding of the oil, except that the water in the reservoir is slightly heavier than the oil, but the head in the condenser is sufficient to prevent this from making any perceptible difference.

I cannot see that filling should interfere with the operation of the lubricator. If it is done right, the water is drawn off and replaced with oil at the same time. The lubricator is then full, as it was before, and feeding has not been interfered with except to be shut off while filling.

In the second last paragraph Mr. Deming speaks of the weight of water above the lubricator. "Weight" is misleading and I would greatly prefer "head." It is possible to have a very heavy weight of water above the lubricator and not have as much head as a ¼-inch pipe affords. It is head that the successful feeding of the heavy oil depends upon.

The boiler scale problem is still before us and apparently always will be. By the order of the "boss" we use crude oil here (in the Canadian Northwest), which acts very much like kerosene. I don't think kerosene dissolves or softens the scale at all, but finds its way between the scale and the steel and by promoting oxidation of the plate, breaks and lifts the scale off bodily. The plate then, instead of the scale, is attacked to remove the scale, which must be bad for the boiler as it thins the shell, but otherwise the plate would be burned and bagged, so we choose the lesser of two evils.

Mr. C. Garman, in his article on cleaning fires, speaks of the nonconducting property of soot. Soot is certainly a very poor conductor of heat, but I believe when it lies in the bottom of the tubes without sticking to the top or sides it does little harm. The sides, and particularly the top, are the main heating surfaces of the tubes, the bottom being of very little practical value. Mud and scale lying on the water sides of the tubes are much worse than the soot, for the mud and scale adheres or rests on the most efficient heating surfaces of the tubes.

I prefer the soot-sucker to the blower. I like Mr. Garman's way of cleaning his fires.

A. L. J. doesn't mean what he says; "the crosshead travels less while making the last inch of the stroke than it does while it is making the first." The inch must be the same in either case. He evidently means that the crosshead travels less for the same movement of the crank on the outer portion of its stroke than it does on the inner portion. The reason for the difference is not because one-half of the crankpin circle curves away from the crosshead and the other half towards it, but the difference is due to the angularity of the connecting-rod. Lengthen the connecting-rod and you decrease the difference, shorten it and you increase the difference. Use the Scotch yoke instead of the connecting-rod and you have the same motion of the crosshead at both ends of the stroke. The crankpin circle surely has nothing to do with the irregularity of the travel of the crosshead.

C. G. Stockwell's truth: "Engineers are always looking and searching for something new, and are tired of hash," brings me to a close immediately. Motor.

Gear Lubricants.

Editor of the Engineers' Review:

In answer to W. M. H., Almira, Wash., in question No. 391, I will say that gearing running exposed to dirt will last nearly twice as long, without lubricants of any kind, than they will with the very best lubricants. I have tried this with the best of results.

Stop and think, when oil or grease is applied to gearing, say on a traction engine, the dust comes up from the drivers direct to the gearing and the lubricant holds the dust and grit and will begin cutting at once, but if the gearing is dry, no dust or grit will stick to it. Geo. K. Haviland.

Gear Grease.

Editor of the Engineers' Review:

I notice one of your readers wants to know which is the best lubricant for gearing on traction engines. I have found that 700 or 750 fire proof cylinder oil works good.

I would like to know what kind of paint to put on the smoke stack and smoke box of a traction engine. I have tried several kinds but it always burns off.

P. F. Turner.

[It is said that a good paint for boiler fronts is made by mixing a sufficient quantity of silica-graphite in boiled linseed oil. It will not burn, change color or blister. Another paint is made by mixing powdered soapstone with a quick drying varnish.—Editor.]

How Does He Do It?

Editor of the Engineers' Review:

I take much interest in reading the letters in the Idea Exchange and wish to try my hand at it.

First, I would like to ask A. H. Strong, in the January Review, how he got his emergency valve which he made from an 8-inch coupling, down through the 6-inch casing of the well? An 8-inch coupling measures something like 8¾ inches on the outside, and as that is over 2 inches greater in diameter than the inside of the casing I fail to see how he got it down.

Next I wish to reply to George Henderson on the much discussed subject of piston travel. No amount of keying up can change the piston travel, as that is a constant quantity depending on the length of the crank. The trouble is, several have misunderstood the question, and I will try to explain. If you key up on both ends of the connecting-rod and lengthen it 1-16-inch that will advance the piston 1-16 inch nearer the head end, but it will be 1-16 inch further from the crank end, so you see the piston travel remains the same. This is what is done: the path of travel of the piston is changed in relation to the cylinder. The peculiar card of Wm. E. Ryan would have been much easier to understand if he had kept the two cards apart, as they are so run together it is hard to follow the direction of pencil travel. It looks to me like a very bad leak in the piston.

I have seen some discussion in the engineering journals as to why a lubricator glass will almost always break when steam is again turned on if it has been cleaned by means of a swab fastened on a wire. I discovered this long ago and have since used a stick of wood and have no more trouble. A few days ago I had some dirt get into the glass tube of a mercury vacuum gage and took a small wire and run it through, and in about 15 minutes afterward the tube broke in two. In less than two hours it had broken in four more places, and later on in the day I noticed two more cracks. Now, I never thought that this tube, being all the time cold and under no pressure and very thick in proportion to the size of hole, would be affected in any way by a wire. I would like the opinions of my brother engineers on what causes this. H. H. F.

Writes About Several Subjects.

Editor of the Engineers' Review:

In the January number of the Review C. G. Stockwell has, I feel sure, voiced the opinion of a large number of your readers. Let us, as he says, get out of the rut, away from all this hash and twaddle about the stroke being altered in the keying up of an engine, the use or nonuse of low water alarms, etc.

J. Wight's separator looks like a good thing, and I think is quite creditable to him. If he could only get a good steam trap now to pipe the drip to, he would be fairly comfortable.

The pipe sketches by L. A. Cole are certainly curiosities; while on this subject I would ask the opinions of readers as to which of the two pipe plans shown in Fig. 1 is considered best practice, and why?

A plant I have visited has the safety valves piped up as shown in Figs. 2 and 3. This to me appears decidedly bad practice. Do boiler insurance inspectors not take note of such an arrangement? *A*, Fig. 3, is the pipe leading from the valves to the air.

Would E. L. Barnett or some other electrically posted brother help out on a question of dynamo overload? The case is that of a small Thompson-Houston machine of uncertain age. It receives good care and attention, yet the brushes and commutator wear away at an alarming rate. The brushes require trimming and adjusting about every two or three days and there is more or less sparking all the time. The engineer thinks there is either a defect in the armature winding or else an overload. The name plate on the machine merely says, 110 volts, 2,500 rev., class, O. S. S. There are 32, 16-candle power lamps on the circuit. Flat places wear on the commutator bars. What is the trouble?

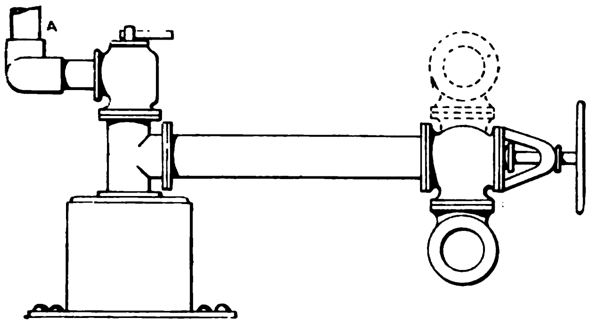


FIG. 1. WHICH IS THE BETTER METHOD?

The question of deception is up for discussion. The case of the fellow who went into another man's plant during his absence and removed the seat from a valve in a line of pipe must surely be the limit.

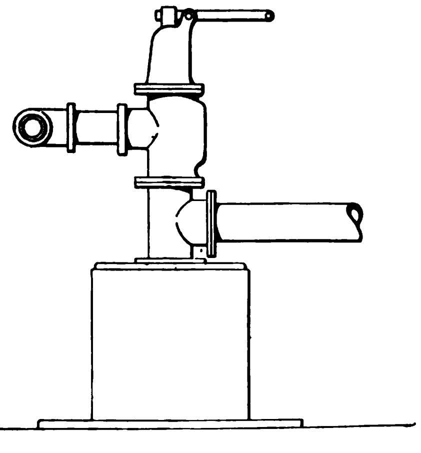


FIG. 2. SIDE VIEW OF VALVE AND CONNECTIONS.

The following came under my personal notice. The machinery of a steamboat had been thoroughly overhauled and during a trial of a few hours under steam, the line superintending engineer took cards and adjusted the valves on the 1,200-horsepower triple main engine. The chief was not a man who had much use for an indicator. At the conclusion of the trial, when the superintendent had taken his departure, the chief ordered the covers off all three valve chests, and proceded to set the valves according to his own ideas, and as subsequent events proved, he made a mess of it.

The boat went to sea next morning, and was not outside two hours when things commenced to happen. In spite of all the oil and cold water available, all three pins heated up, as did also several of the bearings. A hose was also kept playing on which ever appeared for the time to be most in need of it. Several ten-day trips were made in this condition, things getting worse all the time. The chief finally resigned for a shore job, so he said.

Of the new crew to take charge, the writer was an assistant, and will not soon forget the shocking appearance of all three crankpin brasses, which we took down for examination. There being no time to send them to a shop, we had to do our best with chisel and file. We reset the valves, and they needed it bad. The intermediate was entirely blind on one end. It was a wonder to me how the engine ran at all. For about a month we had more or less trouble. Then we began to get a little rest and peace of mind. To my knowledge that engineer never held a job much over six months afloat or ashore.

I see that D. Parker tells of having trouble with a fusible plug and how he played a joke on his boss. He blames the plug trouble on the dirty liquid of the Chicago river. I have had some experience with that turgid stream and know of its trouble making qualities. Still it never bothered our soft plugs, nor do I remember of hearing of others having trouble in that line. Has Mr. Parker told us the whole story? May his boiler not have been foaming? Was he quite sure of the water line? Again, fusible plugs are not of much account unless made of proper metal. I have seen plugs blow one after the other with the best of water, simply because they were improperly made. As to his deceiving his employer about it, I cannot see the necessity for his doing so. Turbino.

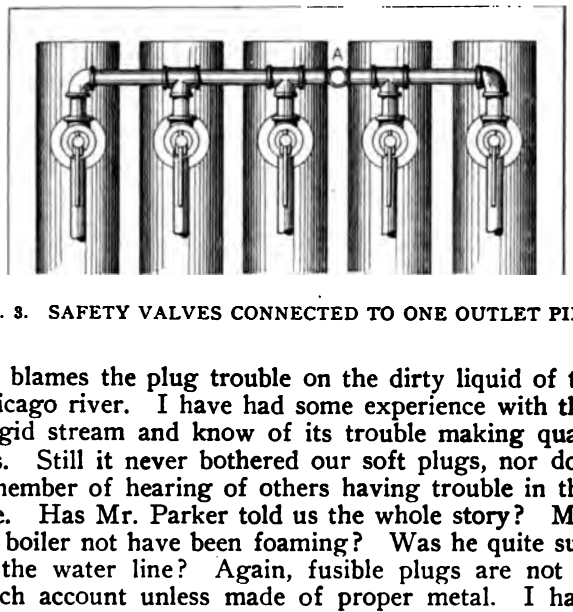


FIG. 3. SAFETY VALVES CONNECTED TO ONE OUTLET PIPE.

Feed Pump Troubles.

Editor of the Engineers' Review:

I have read with much interest the letters in the Review, especially those brought out by Grafton's letter in late issues, on deception in engineering practice, and I think we all might as well plead guilty.

I would like to mention a few pump troubles I have encountered. I recall one that puzzled me not a little in a small plant I had charge of, where there was only one means of boiler feed, and that was a small duplex pump that had proven itself equal to the duty required of it until it gradually dawned upon me that the pump was having a hard time to do the work it had previously done so easy.

As we did not run at night I took the water end apart, but found nothing to indicate why the pump would not do its work. While the cover was off I opened the valve from the city main and the water rushed up through the valve opening, which satisfied me that nothing was wrong with the suction. I then put the pump together and started it with no better results than before. As the boiler was working light I felt confident I could pull through the next day without having to shut down, and the next morning after worrying for two or three hours I got water enough in the boiler to allow me to stop the pump awhile and make another inspection. This time I disconnected the flange joint in the suction pipe, but did so feeling I was wasting time, but to my surprise on running a packing hook up in the goose neck I pulled out enough hay to make a good sized hen's nest. Of course that ended my trouble, but I got an injector added to the plant on the strength of the close call I had from having to shut down.

Another instance I met with was in a different plant where we had a battery of three boilers, fed by two duplex pumps, which also had to furnish water to a mud mixing machine. One of these pumps was a very small affair and would not supply the water needed alone, and one day the big pump, as we called it, suddenly failed. When the fireman called my attention to it, I was busy in the engine room at the time with three engines to look after. I went out and saw that the pump in question was speeded up to about the limit and apparently worked all right with the exception that one piston was making a quicker stroke than the other. I let the pump run and started the smaller one knowing that we could keep things going until I could make up my mind what was wrong. I soon decided that it must be the piston head in the water end on the side that had the jerky motion, so I took the cylinder head off and the piston head fell out on the floor as the cotter key in the end of the piston-rod had rusted away and allowed the nuts holding the piston to work off. The piston head was shoved up against the cylinder head and remained there until I took the cylinder head off. Things were soon in their place and all was well in that case.

Another pump deal that I was steered up against was an automatically controlled pump which was situated quite a distance from the engine room and was looked after by the general repair man. The pump was causing him quite a lot of bother, so he called in the master mechanic, who decided the brass bushing in the water cylinder needed reboring, which was immediately done. Things were put together again only to find that the trouble had multiplied, as the pump would not now hold packing in the water piston any longer than it would take to put it in.

I had been expecting to have the duty of looking after that pump added to my already numerous ones, but had steered clear of it as long as I could until the superintendent, who had been worried considerable by the troublesome pump, invited me to take charge of it and see what could be done. I knew the water cylinder bushing had just been rebored, so I thought I would see how it looked inside, and on taking the head off I found that reboring it had left the diameter of the cylinder about ½-inch larger than that of the follower plate. I had a new plate cast to fit the cylinder as it should and our troubles were over once more.

Troubled Pumper.

Rope Information.

Editor of the Engineers' Review:

In the February Review I see Mr. R. wants to know through the Review how to splice a rope and give illustration. I will advise him or any one else to write to the American Mfg. Co., 65 Wall street, New York, for their book called "A Little Blue Book on Rope Transmission," which tells all he wants to know.

C. G. B.

[The A. Leschen & Sons Rope Co., 920 North First street, St. Louis, Mo., also have a catalogue on the above subject which will be sent for the asking. — Editor.]

Rope Splicing.

Editor of the Engineers' Review:

I see in the February number, page 19, that R. wishes to know how to splice a rope. If it is how to splice a cotton or hemp rope for power transmission, he can find an excellent method by forwarding 10 cents for the January number, '05, of "The Textile American" to the Textile American Publishing Co., Old South building, Boston, Mass.

The method there set forth is an excellent one and is very simple, and is recommended by the Plymouth Cordage Co. I have used the above splice on very hard work and experienced no trouble.

I would like to ask your readers whether there is more danger in having a safety valve too large or too small? I contend that a safety valve should be large enough to be able to care for all the steam the boiler could generate if the occasion required.

D. W. Bowen.

Emptying Gasoline From Barrels.

Editor of the Engineers' Review:

Of the many ways of emptying gasoline from barrels, it is generally agreed that syphoning it out through a rubber hose is the best. My experience is that there are many ways of starting the flow through the hose, but lately I studied out a way which is O. K. I have a string a few inches longer than the hose. Upon one end of the string is fastened a plummet which will carry the string through the hose, and on the other end of the string is tied a bunch of rags of suitable bulk. I pull the string till the rags are well within the end of the hose, and then poke the hose, rag end first, into the barrel. When I am sure the inner end of the hose is at the lowest point of the barrel I hold the hose in place with one hand and with the other hand pull the string and rag out of the hose and the gasoline comes every time, even in the hottest weather.

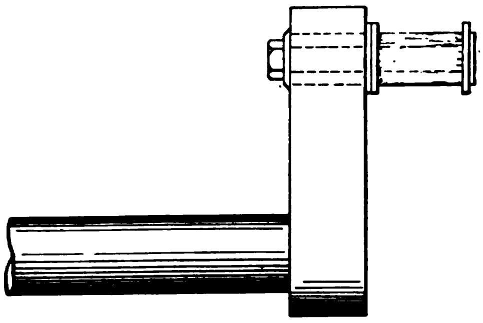
James M. Ray.

Leather Covering for Pulleys.

Editor of the Engineers' Review:

As I have just completed the job of covering several pulleys with leather, it has occurred to me that ıps an explanation of how this was done might help to some of your readers.

is known to most engineers that with a given ten- of belt, nearly three times as much power can ansmitted when the pulley is covered with leather ith a smooth surface. It is a comparatively easy :r to cement leather to the face of a pulley for st any length of time, or at least until the leather vorn out, or is torn from the face of the pulley by extraordinary force. It is as easy to make a nt that will work on iron and leather as it is ake a cement for wood or any other porous sub- e. The way I make my cement is to take a cer- ımount of glue and cover it with an equal weight ater and let the whole stand for 24 hours, until vater is completely absorbed by the glue. I then this mass in a water bath until the glue is melted. 'ater bath I mean placing the glue pot in another ıaving water in it, in fact it is the same as an ary double kettle. When the glue is melted it :s a concentrated glue solution which is to be d upon the surface of the pulley after the er has been prepared. In getting the leather r for application a strong solution of tannic acid ld be used for moistening the leather before it is ed to the glued surface. The solution should be ed warm. It is necessary to roughen the surface e pulley by cross filing or if preferred, by the use ı acid before the glue is applied. The glue should be applied warm. I have found that leather used overing pulleys can be cut from pieces of old belt lit leather.



WOODEN PIN FOR ROCKER ARM.

ıt only does covering a pulley transmit more :r to the belt, but it is also a means of enlarging liameter of the pulley and if one course does not ; the pulley to the desired dimension, another can ıt on top of the first. In fact three or four thick- :s of leather applied in this way can be securely ned together by the glue and tannic acid, if the :ce of the leather is roughened before the glue is ed. If any one having pulleys to cover will fol- :he above instructions they will be surprised at the with which the job is accomplished.

have been much interested in the description of method used in repairing different breakdowns ı have occurred to some of the contributors to magazine. I thought that perhaps a little ac- : of how an emergency repair was conducted ı was brought about by the breaking of the pin in a rocker arm would be interesting. Just what broke the pin has never been found out, as very little strain comes upon it, and in order to keep things moving we resorted to the following: The old pin which seemed to be full of flaws was removed, and as we had no machine shop handy to make a new one in time to keep the engine going, we made a wooden pin, as shown in the illustration. The pin was made of seasoned white oak and turned in a wood lathe to the desired dimension, after being drilled out for a bolt. It was then placed in position as shown, the head of the bolt being cut off about half its thickness and the corners rounded to make a neat looking job. The end of the bolt on the inside of the rocker arm was cut off even with the nut. This kept things going until we had a new steel pin made. M. B. Greene.

How Does It Work?

Editor of the Engineers' Review:

In looking over the Review for February, I noticed a sketch of a damper regulator by Lindon A. Cole. It seems easy to make, but isn't it possible that Mr. Cole overlooked some part or am I too dull to comprehend it?

I can see how the regulator would close by the steam pressure overcoming the weights and forcing the piston up and the weight on the damper closing the same, but I cannot see any way in which the steam pressure or weights will cause the regulator to open again, as I see no provision made at the bottom of the regulator for the escape of water or steam unless the weights are heavy enough to force water or steam back into the boiler, and I should think that would cause quite a variation in steam pressure.

I consider a good damper regulator a fuel saver and a safety device to a certain extent. Will Mr. Cole please explain? H. S. C.

Leaky Pipes.

Editor of the Engineers' Review:

Some time ago the top ¼-inch pipe which leads to the condensing chamber of my lubricator broke in the thread next to the ell. I had to shut down the engine and when I tried to get the broken piece of pipe out of the main steam pipe I found that it could not be done without breaking it. It would have taken too much time to remove the covering from the main steam pipe so I could cut out the old pipe, so I got the pipe dies and cut a thread on the pipe without removing it from the main steam pipe. In doing this the top pipe was made short, so in place of putting the old pipe back again, which leads down to the condensing chamber, I put in a new one with an offset like that shown in Fig. 1.

In another case the ¼-inch pipe began to leak where it screws into the main steam pipe, and screwing it in further would not stop the leak. I put in a new piece of pipe, but it still leaked. Upon examining the hole I found the threads were all worn out. The next Sunday I reamed out the hole in the main steam pipe so I could get in a ⅜-inch pipe, and then put in a ⅜ x ¼-inch bushing as shown in Fig. 2, which stopped the leaking.

Seeing so much about banking fires in the Review I thought I would give my way of doing this work.

About half an hour before I shut down at night I run the steam pressure up to the blowingoff point, and then a short time before I shut down I shove the fire back to the bridgewall, close the damper, and ashpit doors in order to cool the fires down as much as possible, and then shut the engine down, when I cover the fires with fine fresh coal. By this method I find that the steam does not run up too high during the night, and I do not have to open the furnace doors.

I have banked my fires this way on Saturday night and have had a good fire on Tuesday morning. Of course, the longer I want the fires to last the more coal I throw on when banking.

Our office is heated with exhaust steam when the engine is running, and when not running we use live steam. One morning I got notice that one of the radiators was cold and the others were hot. I thought it was froze so I disconnected the supply pipe, but it was all right. Then I disconnected the outlet pipe and that was all right. I connected all of the pipes together again and turned on the steam, but it would not go through. I could not see what was the matter, as the air valve was in good working order.

When I turned live steam on the radiator got hot, but when I then turned the live steam off and tried the exhaust it failed to go through. I then disconnected the outlet valve from the pipe and found the disk had come loose from the stem. Then I saw at once where the trouble was, as there was not enough pressure in the exhaust steam to lift the disk and let the water out of the radiator, but when I turned live steam on it lifted the disk and forced the water out. I repaired the valve and had no more trouble. J. H.

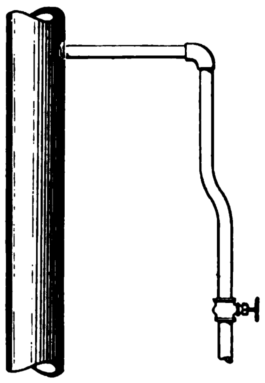


FIG. 1. OFFSET PIPE.

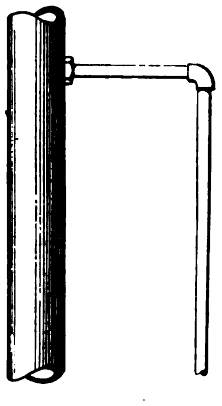


FIG. 2. BUSHING IN THE PIPE.

Bagged Boilers.

Editor of the Engineers' Review:

The early experiences of N. Decatur with bagged boilers in a recent issue of the Review was quite interesting, and as we have had considerable experience with boilers in the plant where I am employed, it might interest some of your readers to know how we do a job of that sort out here in the wilderness. We have a battery of two 72-inch x 18-feet return tubular boilers, fired with automatic stokers. We have had considerable trouble with leaky tubes and bagged sheets. The last time the boiler was opened for cleaning we found the sheet over the fire was quite badly warped, as shown in Figs. 1 and 2, and as we do our own repairing it was up to us to drive up those bags. We took the grates out and built up a platform in the fire box and proceeded to do business. If any of your readers have had experience along this line they will know that it is indeed very violent exercise, also that the parties involved need asbestos faces.

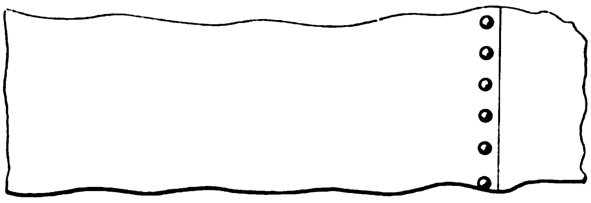


FIG. 1. BAGS ALONG THE BOTTOM.

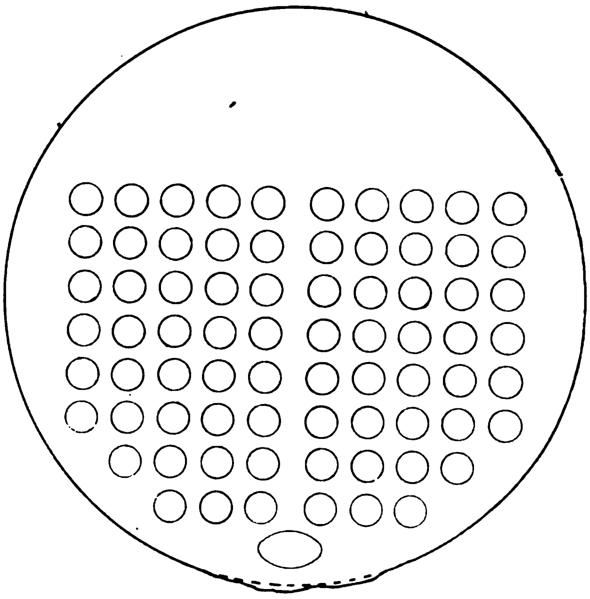


FIG. 2. THE BAGS AS SEEN FROM THE FRONT.

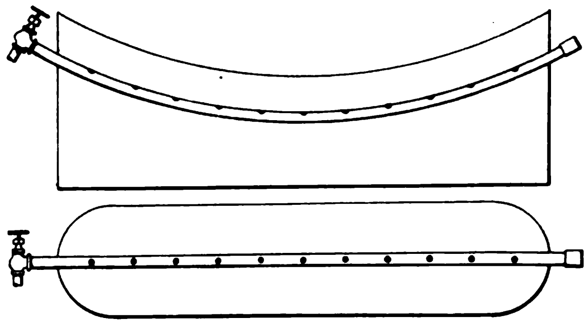


FIG. 3. FORGE AND AIR BLAST.

We made a forge out of the uptake of a 60-inch Economic boiler, as in Fig. 3. The air pipe is made of a piece of 1-inch pipe, curved the same as the top of the forge and has holes drilled about 1 inch apart

along its upper side for the air blast. A hose run from the compressor and connected to the forge furnishes the air.

We next built a wooden platform to set the forge on. Fig. 4 shows the forge under the boiler. After getting the forge in good working order we started a fire of pulverized coke under one of the bags. We put a couple of rails on the bottom inside of the boiler, then covered them all up with charcoal so it would heat from both sides. When we got the bag to nearly a white heat we shoved the forge back out of the way and four of us, two at a time, proceeded to drive up the bag, by driving around the outer edges and finally finishing up on the center. Great care must be taken to not drive too hard in one spot or the result will be a flat spot on the boiler. Broox.

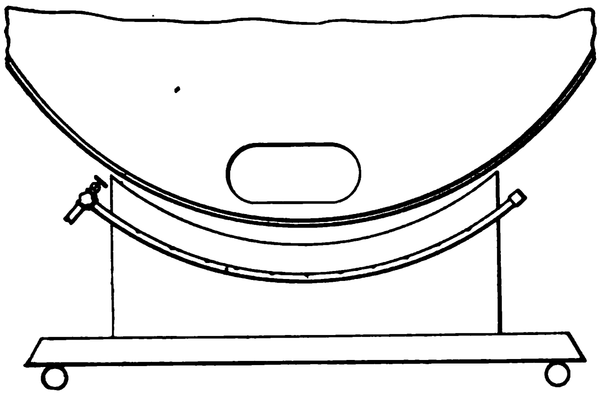


FIG. 4. FORGE IN PLACE UNDER THE BOILER.

Smokeless Firing.

Editor of the Engineers' Review:

I see in the February number that W. C. Bosworth has devoted about two columns of paper and doubtless several hours' time trying to answer my letter about smoke. He doubtless thinks because I have taken the name of "Whiskers" I am an old timer with a long white flowing beard and like Rip Van Winkle have been asleep for the past 20 years, as he says my idea would have been all right 20 years ago. In that as in a few other things he is mistaken.

In my letter in the December number the smoke saving device mentioned was a sort of blowing device placed in the stack to induce more draft and was run by a small engine and was supposed to be started and run for a few minutes after each fire.

Mr. Bosworth says, "There is not much danger of a labor-making device being recommended by engineers." I agree with him there. That is why I prefer hand firing to any stoker I ever saw. I will admit my knowledge of stokers is limited, but it is not so limited that I would try to make people believe that all the fireman has to do is to fill the hopper as he has stated. I will say I am quite familiar with several types of stokers and am at present running a plant equipped with stokers and although they do not make much smoke they do not make it any easier on the fireman.

In another plant where I was employed as fireman there were six 200-horsepower boilers of the Wickes vertical water tube type. Four were hand fired and two stoker fired. There were two firemen on a shift and one man fired the four hand fires and the other the two stokers, and we all preferred to run the hand fires rather than the stokers. Then as the plant increased in size it became necessary to install three more boilers, but they did not put in any more stokers. Now if it was such a saving to use the stokers why didn't they do it with the other boilers?

Then he tells how making smoke without stokers is the fault of the fireman. If that is the case why not educate the fireman so it will not be necessary to install stokers. I will wager any reasonable amount that I can fire by hand with as little smoke as Mr. Bosworth or any man he is a mind to pick up, but I know I can't fire without making lots of smoke.

Mr. Planters says that if the valves of a duplex pump are set right one plunger stops as the other starts. Now I think if they are set right one plunger will start just before the other stops and thus prevent as much pulsation as there is in a single pump. Whiskers.

Smokeless Firing.

Editor of the Engineers' Review:

Mention has been made of late of smokeless firing, stokers, etc., and I would like to say a few words in favor of the mechanical stoker. Our company lately erected a new boiler plant and equipped the boilers with mechanical stokers. While I saw the work progressing I thought "What a fake." I had seen stokers before of a different type and they were a "fake" so far as economy, work and cleaning fires were concerned, so I naturally was prejudiced against any kind of an article that looked like a stoker. When we got those in the new plant working I thought, what a "God-send" to the fireman, no fires to clean, no ashes to pull out, no coal to shovel and the chief used to say "When we get her going the boys can come to work with white shirts on."

It is hardly as good as that, but what an improvement over the old hand firing. One man takes care of five boilers and we burn about 40 tons of coal a day. Overhead are the coal bunkers and the coal comes down as fast as needed. On the side of the boilers are the little engines which drive the stokers, while underneath is the ash car. All the fireman has to do is to throw a lever and his fire is clean and his ashpit is empty. This corporation before installing stokers, employed six firemen, now two men do the same work and have a much easier time than six did, and as for smoke, the only time that I see any smoke is when the plant is idle and the fires are deadened, but if they made more smoke, I would still think they were a blessing when compared with hand firing. I have done a lot of it, but to fire without smoke, I never could.

This calls to mind a place where the engineer told the fireman to make less smoke. His reply was that if he would white wash the coal he might do it. The only reason I can give for the lack of smoke by mechanical firing is that the coal is fed so even and so slow. On the other hand where you throw on several shovels of coal it seems impossible, to me, to prevent smoke.

The letter of N. Decatur on page 39 of the February issue calls to mind an experience I had a short while ago. In the country where I live, steam shovels are about as numerous as stationary engine plants. Connected with the plant I have charge of is a direct hoist that hoists at the rate of about 2,000 feet a minute. The engine room force consisted of but four men, two engineers and two brakemen. The chief never felt the necessity of having an extra man for the engine crews, in case of emergency. One day one of the regular men was taken sick and had to have an operation performed. He might be gone for several months and perhaps for good, so it was up to the chief to get a man to operate this hoist. As it was in the winter time the steam shovel work was at a stand still. The company had a young man who was considered a first class shovel runner and he was sent to us to break in. I spent a week with him and the man on the alternate shift spent a week with him, when we thought he was O. K. For two days after we left him he did his work and did well, but on the third day at noon he complained of not feeling well, so I had to let him go home. He admitted later that he hadn't nerve enough to run the hoist. It goes to show that while a man may be an expert at one position he might not be worth anything at another. I think though that there is no machinery that will take the heart out of a new recruit as quickly as a fast hoist. I have seen many good strong men who ought to have nerve and who have worked in and around steam plants for years fall down when it came to hoisting.

W. E. S.

Kerosene in Boilers.

Editor of the Engineers' Review:

About 15 years ago our feedwater was very bad and every idea was resorted to in order to prevent scale. Compound of all makes was used, filtered soda ash and kerosene oil. We had a new Fitzgibbons boiler. The man who run it wanted to keep the scale out and sent for the boiler inspector to call and see the new boiler. He came and they had a talk about scale and the boiler inspector recommended soda ash, and I fixed my pump for soda ash.

The boiler was in an office building and as I had but one I had to run as long as I could without washing out. I ran for four weeks and then washed out, when I was surprised to find considerable scale, and it was pretty bad. I then got the manager to buy a kerosene feeder and I fed in kerosene drop by drop, using a pint in 10 hours, and at the end of the month I washed out and found no scale, only mud. I am of the same opinion as Mr. Ludlow in the November issue, who thinks if kerosene oil is used properly it will do the work.

Caleb.

Dirty Boilers.

Editor of the Engineers' Review:

I notice "Whiskers" in a recent issue of the Review says he examined the dirtiest boiler he ever saw and lays the blame all to potatoes. Did my friend "Whiskers" ever stop to think or figure on the amount of vegetable matter pumped into a boiler in one week's time?

Unless the boiler is taken care of as it should be it is bound to be dirty. I usually use soda ash or compound to prevent scale forming, yet all of this would be better in a barrel headed up tight, than put into a boiler which is not taken care of after the compound is used.

I think it is criminal to run a boiler over one week after a scale solvent of any kind is used, if the boiler is scaled to any extent, as the scale will settle to the bottom of the shell and be liable to cause the sheets to burn.

I have used potatoes with good results, but I always wash out the boiler thoroughly within one week after putting them in. Potatoes seem to make a smooth surface on the inside of the plate and I don't think scale will be as liable to stick to the shell and tubes, at least that has been my experience.

I have had the care of from one to five boilers for about 25 years and can honestly say that only one was ever laid up for repairs. That was one of a battery of four return tubulars. After cleaning this boiler it was filled and fired up on Monday morning and at about 10 o'clock I noticed a small bag directly over the bridgewall. I cut the boiler out, cooled it down, set up the bag and then took out the handhold plate in order to find out, if possible, the cause of the bag. I found the boiler as I had left it, perfectly clean. No tools, waste, etc., left inside as I was afraid I would find.

I could not account for it in any possible way. I studied on the case until the inspector from the insurance company came along. I then asked him to solve the mystery. He told me that the probable cause was when I cleaned the gasket from the manhole which was directly over this place, I must have dropped a little of the rubber gasket, which had melted and stuck to the sheet and so prevented the water from reaching the plate which had allowed the sheet to get overheated in that particular place. At any rate that was the first and last time I ever had trouble with boilers in my charge.

C. H. Prescott.

Putting Cold Water Into Boilers.

Editor of the Engineers' Review:

As I have been a reader of your paper for some time I have concluded to write a short letter. I think that all engineers should be compelled to hold a license. I had an opportunity to visit a saw mill recently where four boilers had been completely wrecked by an explosion, five men killed and two others injured. I carefully inspected the wreck and everything indicated that the boiler had been red hot below the bottom row of tubes. After I had made up my mind that there had been no water in the boilers, I went into the mill and met a man who was employed by the company and asked him where the engineer was at the time of the explosion. He replied that the engineer was at the store, some little distance from the mill, and that the fireman in charge was a green hand; that he knew the water had been out of sight for more than half an hour and that the fireman had been pouring water on the injector in an endeavor to get it to work.

Afterward I talked with an old-time engineer in regard to the affair and he said it was impossible for a boiler to explode on account of low water; said he could put cold water in a red hot boiler with perfect safety and declared that it was all old fogyism to say that a red hot boiler will explode from turning cold water into it.

I notice a great deal being said about boiler scale and the use of compound. I find in my experience that the same compound will not work the same in all cases. I have found that, in some cases, kerosene oil is a great help. Soda ash, too, is all right. I make a practice of washing out my boilers every two weeks, but I never blow them down while hot. On Saturday evenings I let the steam go down with about three gages of water, then fill up to the top of the gage glass and let it stand until the next morning. Then I can wash out the mud easily as it does not bake to the boiler shell. I do not have much trouble with scale. I also use the blowoff in the evening after the day's run is made. I bank my fires and let the boilers cool down while I go to supper; then I go back and see that there is only about 30 pounds of steam; then I open the blowoff slowly and a circulation starts from over the fire, which I claim is the hottest place in the boiler, and it flows toward the blowoff and in that way I get rid of a portion of the mud and scale. I blow out only a small amount of water each evening.

Henry S. B.

Boiler Experiences.

Editor of the Engineers' Review:

The article published in the February issue regarding the failing of the bag on No. 2 boiler in the Vulcan building, Cleveland, Ohio, brings to my mind a very narrow escape I had two years ago from a burned boiler, and although it may sound fishy, it is nevertheless a fact. I had charge of a plant at a coal mine which consisted of two 66-inch x 18-foot boilers; one 160-horsepower McEwen engine and a 100-kilowatt dynamo. We mined the coal by electricity, the mining being done at night and hoisted in the day time. I was on the night run.

We had to depend on a pond for our water supply and as the season was dry we ran out of water. There was plenty of water in the mine and we had a pump to pump it with. I had not been there very long and did not know anything about the water in the mine, but the water was as pretty and clear as any I ever saw.

The general manager came around and concluded to use that water. We ran one boiler at a time and things went very well for a week, but I saw the water was pretty bad. I had been running a boiler two weeks on the other water before cleaning, but I just cut that boiler off after one week's run. I cleaned out and filled up No. 1 boiler, which was in fine shape.

I run this boiler two shifts and started on the third when I noticed the water was somewhat worse than what it had been the week before, so I told the superintendent I was afraid we would burn the boiler, but he seemed to think differently so I let things go, but I never shoveled any coal under that boiler until I looked under it each time, and it was a good thing I did.

Along about the last of the shift I looked under the boiler and it being all right I fired up. As the load was light I did not have to fire very often and had let the pressure drop a little more than usual. When I went to fire up again I heard a sound of escaping steam which attracted my attention, which came from the direction of the boiler. I opened the furnace door and peeped in and —well, I didn't know whether to run or stand my ground, but I stood my ground.

There was not much fire in the furnace and everything looked dead, but there was a hump on that boiler like a salt bag and a little steam blowing from the bottom of it. There was about 70 pounds of steam on the boiler at the time, so I just closed up the ashpit doors and let everything run to relieve the pressure as fast as possible. I run the pressure down to about 20 pounds when the engine dropped its speed and I shut down. I opened the boiler up the next morning and I will not venture to say how much sediment there was in the boiler. The plate was evidently burned from one end to the other, but the bag was over the fire box near the bridgewall, that being the hottest place.

We had to cut out a piece that measured 3 feet 9 inches by 4 feet in order to get good plate to work on. The boiler was, of course, patched. Several inspectors said it was the largest bag they ever saw and it is the largest I want to see unless I see it as they did, cut out of the boiler and dumped to one side.

The bag had come down until it was very thin and was split slightly at the lowest point where the steam and water was blowing through.

I consider that a pretty close call, but some say that a miss is as good as a mile, but when I know it and can, I would rather risk a mile. D. S. D.

Mechanical Stokers.

Editor of the Engineers' Review:

Mr. W. C. Bosworth writes a most interesting letter in the February number of the Review about "Smokeless Firing." I agree with him in every point and believe that most engineers who have had the opportunity of using underfeed stokers will do the same. I say underfeed stokers, for my experience with other kinds is not remembered with any degree of pleasure.

It seems to me that the method of supplying the furnace with fuel, used by the underfeed system, comes the nearest to being the ideal method of any. I do not wish to extol any particular stoker but am speaking of the principle of forcing the coal into the furnace under the fire instead of putting it on top of that already in the furnace.

But as Mr. Bosworth says, it is impossible to fire without making smoke when the fires are forced, and in many plants, that is most of the time.

If, when underfeed stokers are used the demands for steam are so great that it becomes necessary to use the fire bar to break up the fires, a large amount of smoke will be made and it will appear at the top of the stack in large quantities and no stoker made and no fireman, may he be ever so capable and careful, can prevent it. When the demands are not excessive, there is no excuse whatever if smoke is made. This is as true when firing is done by hand as when stokers are used, when a good grade of coal is used.

The advantage of the underfeed stoker is more noticeable with the poorer grades of coal than it is with the better grades. During the coal famine of two years ago we had to use all kinds of stuff for fuel. One cargo which we had was so gaseous, that when firing by hand, under our vertical boilers the gas would take fire in the flue heating it to a bright red, and a stream of heavy black smoke was issuing from the stack almost continually. But when we used the same coal under the same kind of boilers, through the underfeed stokers, very little trouble was found and the smoke was not unduly excessive. S. J. Smith.

Engine and Fireroom Equipment.

Editor of the Engineers' Review:

I suppose that you will expect to get a letter treating upon all the fancy flummeries with which an engine and fireroom are supposed to be equipped after reading the above title, but such is not to be. I just want to call attention to some of the conditions I have noticed in steam plants which are entirely opposite to the accepted practice of what they should be.

As a rule the ordinary engine and fireroom outfit consists of everything in the line of tools that have either been borrowed, begged, stolen, or accepted as presents from other departments where they have outlived their usefulness.

Very few engine rooms have a convenient place wherein a pipe vice can be set up for the use of the engineer, where he can do the repairs that are more or less frequent. Of course engineers are expected to do repairing and one thing which is needed is a good bench made heavy enough so that when the engineer is cutting a thread on a piece of pipe he will not twist the bench all over the engine room, or when he is making up a length of piping containing joints, tees, etc., he will not be obliged to get someone to hold one section of the pipe on the floor with a Stillson wrench while he endeavors to screw the connection in place with another.

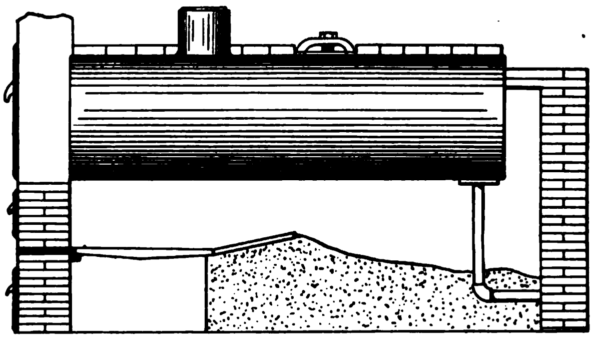


FIG. 1. BRIDGEWALL AND COMBUSTION CHAMBER.

This is a trick that I have had to resort to more than once and doubtless other engineers have been forced to do the same. Every plant should have a complete set of pipe taps and dies, with stocks and pipe cutters, to work on from ⅛ to 2-inch pipe. It will be found that such an equipment will pay for itself in a very short time when it comes to pay pipers' bills at 60 cents per hour. Of course it goes without saying that there should be a supply of wrenches of different styles, even down to the good old-fashioned monkey wrench, to which so much trouble has been blamed.

While we are on the subject of fireroom perhaps it will be interesting to show the way in which I have my grates, bridgewall and blowoff valve arranged. As will be seen by the illustration, Fig. 1, the boiler has a steam dome and I will go on record right here by saying that I have no use for a steam dome on a boiler, and if mine ever gets to leaking or has to come off it will never go on again. Although the one on my present boiler does not leak, I have had plenty of them that have, and as far as I can see their only use is to annoy the man in charge of the plant. It will be seen also that the bridgewall is made different from the generally accepted practice insomuch as it lies on a slant. This is to allow for pushing the live coals back from the grate when cleaning fires. By this method the grate may be entirely cleaned of ash and clinker and the fire drawn down again with a loss of very few moments; in fact the fires can be cleaned almost while the attendant would be barring the coals over on one side when cleaning in the ordinary way. By this method a fire does not have to be burned down as low as is usually the practice, because it is an easy matter to shove the layer of live coals back, leaving nothing but dirt upon the grates, which is almost impossible to do when trying to shove them to one side. I find this is a convenience in the case of boilers which are being worked nearly to their limit.

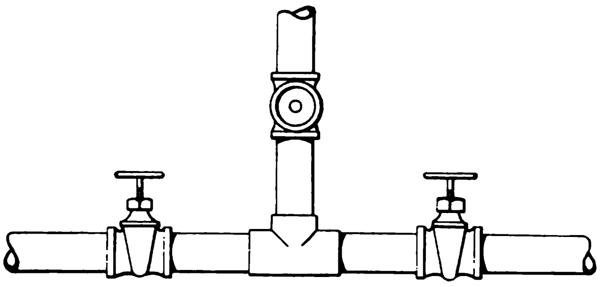


FIG. 2. CIRCULATING PIPE.

I have read some letters regarding the matter of cleaning fires, but I will say most emphatically that some of the methods could not be used in my plant. I have an idea there would be a pretty kettle of fish if I should attempt to allow the fire to burn entirely out on one side when getting ready to clean. I am of the opinion that everyone would have a chance to take a rest while the steam was being raised to its proper point again. That method will apply to plants where the load on the boiler is light, but I would not advise any one to try it where the boiler has anything like a load on it. I have read also where the engineer after cleaning one side immediately cleaned the other. He couldn't do it in my plant and keep running at the same time; if he did it he would have to shut down while he was getting up steam. I don't think my plant is an exception either, because I know of others which would act the same way.

There has been considerable said in reference to the location and position of the blowoff pipe. I think the method as shown in Fig. 1 is the most sensible of any, because the elbow and horizontal pipe is protected from the hot gases while the vertical pipe is always full of water and there is little liability of it being filled up with scale.

Another thing that has interested me is the piping of the blowoff and circulating pipe. The way I have mine connected is shown in Fig. 2, which is practically the same as others have described with the exception that I use a gate valve. I have not had any trouble with scale lodging in it as yet. W. C. Garman.

High and Low Water Alarms.

Editor of the Engineers' Review:

It seems as if the boys hardly get through discussing one topic before another comes up. In the March issue quite a number have more or less to say regarding high and low water alarms, and I heartily agree with F. C. H. when he says: "While the appliances are all right the attendants are not." It is good deal as W. E. S. says in the following letter, that the safety column is O. K., but it is evident that the safety water column can be neglected to the same extent as the ordinary column, and a column without a whistle is just as liable to clog up as one having one. I agree with him again when he says he fails to see what column will be safe if the engineer fails to blow it out as often as is necessary.

F. E. Warfield says in his letter that the alarm column tends to make a certain class of engineers careless and negligent, at the same time admitting it is no fault of the device. He ends up his remarks by stating that some men rely upon them just the same. I know this to be a fact, but because the water column is equipped with a high and low water alarm whistle there is no excuse for the fireman to allow his water to get any higher or lower than it should be, in fact he should be just as particular to keep his water level, at say the second gage or wherever he has found by experience it is most desirable to carry it, as if there were no alarm on his column. When this is done the safety column is doing what it is designed to do, and the whistle is only heard to blow when the fireman through oversight or negligence, has allowed the water to get either too high or too low.

In all my experience as an engineer I have never been troubled with the water in my boilers getting to the dangerous point either high or low with one or two exceptions, and these were in cases where I did my own firing and was busily employed doing some one else's work around the shop when I ought to have been in my engine room, "holding down an old chair," as some one put it.

The plant where I am located now has three B. & W. boilers, each equipped with a high and low water alarm, but it is very seldom the fireman allows them to blow for either high or low water. He is a good man and does not depend upon his whistle blowing to notify him of the fact that his water is not at its proper level. In our plant we regulate the speed of the pump so that it is in constant operation at all times and as far as alarm goes it might just as well be in the repair shop.

When I came to Mr. Jarvis' letter it appeared to me from the tone that he must be interested in high and low water alarms in some way or other. The portion of his letter relating to the increased duties of an engineer and fireman which were brought about by the introduction of a safety water column it seems to me does not portray an unbiased vew of the situation looking from both sides of the question. He says he does not think it unreasonable to expect the engineer to put in his time in doing something besides holding down an old chair. Mr. Jarvis is not the only man in this world who has the same opinion, as can be testified by hundreds of engineers who are obliged to do outside work which in reality they should have nothing whatever to do with. For instance we will suppose that Mr. Jarvis is a salesman for some high and low water alarm. He gets a salary and possibly a commission on all sales made. He gets paid for what he does or rather his ability to sell goods. He isn't on the jump all the time and there are days when he is at the home office, but he would not think much of his employers if they should request him to step into the office and help the bookkeeper with the accounts, seeing that he was not just then actually engaged in selling some one high and low water alarms. I have my doubts as to whether the employer would make such a request, and then again I have my doubts if Mr. Jarvis would comply with the request if it were made.

I fail to see why an engineer whether he is running a small plant, first assistant in a large plant or chief engineer of a number of plants should be expected to attend to any duties other than those which fall directly upon him by virtue of the position he holds. The chief engineers who have charge of several steam plants receive salaries of from $2,000 to $3,000 a year and some of them perhaps more, but I will venture to say they are not requested to go around scrubbing floors, fixing machinery and such work. Their employers would not think of asking such a thing. The same thing with a chief engineer of a single plant. His duty is to see to it that the plant is operated as it should be, and that is all that is expected of him, but this phase of the question changes radically when we come down to plants having from 1 to 5 boilers with a fireman assistant in the one and the engineer doing his own firing in the other. Here we find that a distinction has been made. The employer does not hesitate to rush into the engine room and order the engineer to line up shafting, fix bearings, lace belts, put in foundations and numerous other things which no more belong to him than Japan does to Russia. Why should this be? The last named engineer who gets anywhere from $2 to $4 a day has just as much responsibility according to his salary as the $2,000 a year man. Just why one isn't as well fitted to receive his salary whether it be great or small for what he knows as the other is a mystery to me. It is worth more than a good many engineers get to stay 10 or 12 hours in the dark, dingy holes where some engine and firerooms are located without doing a tap of work from morning until night. My impression is and has been for some years that a law should be passed prohibiting an engineer from doing work outside of his engine or fireroom.

S. H. R.

Engineer vs. Fireman.

Editor of the Engineers' Review:

In reading the letter by S. E. on page 19 of the March issue of the Review I read this question. "Can a man be a successful engineer if he has never been a fireman?" This opens up a question to which I suppose every engineer has an opinion of his own. and he will doubtless render judgment according to his experience; that is the way I propose to do in answering the above. To begin with, it will, of course make a difference as to what the term "fireman" applies to. If it means that a man must have served a certain number of months or years in the fireroom having charge of nothing else but the boilers, or having a chief engineer or fireman over him, then I will confess that I have never been a fireman. If it means the man who does his own firing and operates and has charge of the engine as well, then I presume I can make claims to being a fireman. If it applies to the man who has never shoveled a pound of coal into a furnace in his life then the question is somewhat altered.

To be a successful engineer it is not necessary for a man to operate as a fireman in front of a battery of boilers for several years. In order to be a successful engineer it is not necessary for a man to even have done his own firing and operate the engines in any particular plant. To my way of thinking, the firing has very little to do with being a successful engineer, and right here I presume is where a good many will not agree with me. A man must understand firing, I will admit, but he who uses the most common sense in regard to the fireroom force, is the man who will be the most successful in that branch of the work. I have seen men who began work as firemen and who will probably die as firemen, if they hold their jobs until that event takes place. I have seen other men work a few months in a fireroom and then throw up the place and secure a position as engineer. I know of a man who is operating engines in one of the largest woolen mills in the East who has never fired a pound of coal under a boiler in his life.

I will say this; I believe a man will be a better engineer from having had experience in the fireroom, and for knowing what it is to stand in front of hot fires and sweat and swear, and what it is to cough up soot for two or three days after cleaning boilers and all that sort of thing. It's a pretty good guarantee when he has been through the mill that he will have some consideration for the men who are working under him as firemen when he becomes an engineer. This will many times avoid trouble and friction with the fireroom force which would doubtless occur if he did not understand these things. A man should also be familiar with the workings of different types of boilers, but it does not necessarily mean that he must have to operate them as a fireman.

There are many firemen today who know very little about the boilers they are operating and in over half of the large plants I will venture to say, that if you ask the firemen who are shoveling the coal a half dozen questions relating to the construction of their boilers, they could not tell you unless they happened to be some of those who have no intentions of staying in the fireroom and are learning all the points regarding the operation of boilers, etc., as fast as they can, having in mind all the while that the engine room is good enough for them.

To my mind it is far more important that a man should be a machinist than a fireman. Knowing how to shovel coal or ashes will not help an engineer when he is several hundred miles from a repair shop and a break down occurs. I know from experience that a knowledge of the machinery and how to do machinist's work is of great value to any running engineer. I know it has stood me a good turn, and although I have had numerous break downs, I am proud to say that I never had to call in the help of some outside machinist to show me how to repair things. If I were to start in the engineering field again I should certainly put in three or four years in a machine shop before undertaking the work.

I am not going to say how successful I have been as an engineer, as it would probably not interest any one if I did, but just to show that it is not absolutely necessary for a man to serve any particular time as a fireman I will give a little bit out of my own life as an engineer. When I was a young man I went to work in what used to be known as the Thompson-Houston Electric Co. of Lynn, Mass., now known as the General Electric Co., where I stayed for six years and a half working in their machine shops. About this time I felt that I wanted to see something of the country, and so I packed my Saratoga and started. I had always wanted to be an engineer, and so becoming acquainted with a man in one of the Western states I obtained the privilege of working nights in a little 100-horse power plant for the magnificent sum of nothing per week. It wasn't money I was after, it was the chance to get on the road that led to it, as I thought. After working two weeks for this princely sum I resigned my position and started out as a full fledged engineer. It wasn't long before I secured a position of chief engineer of a 250-horsepower electric lighting plant owned and operated by a small city at the enormous price of $40 per month, seven days a week and sometimes a day and night thrown in for good measure. While this salary seems small now, and it was small, I had this to content myself with that it was as much as other men were getting at that time, who occupied similar positions. My father had been an engineer before me, and naturally I had picked up considerable about the business, but just the same when it comes to actual experience either in firing or engineering I was an absolute greenhorn.

I can say this, however, without any attempt at blowing my own horn, that from the day I started out as an engineer up to the present time, which is over 12 years later, I have never had a serious accident, and in no case has the accident been one where it could have been avoided as far as my knowledge goes. In my first plant I had a fireman and assistant engineer. In plants since then I have done my own firing and engineering, while in other plants I have been an assistant to a chief where firemen were employed. It seems to me that looking at the manner from my point of view, it is not necessary that an engineer be a fireman in order to be successful in his calling. T. E. C.

Fusible Plugs.

Editor of the Engineers Review:

I have read what B. L. C. says in his letter on page 25 of the March issue of the Review regarding my putting a solid plug in the boiler head in place of the fusible plug in order to prevent its melting out. I think that he takes it too much to heart and is really making a mountain out of a mole hill. I do not dispute for a moment the assertion that fusible plugs are very important adjuncts to a boiler, but I will say, that if they are to be of any use whatever they have got to get a good deal more attention than they do from the average engineer. I will venture to say that the plugs in the boilers of B. L. C. haven't been examined for the last six months, by himself or any one else any more than a casual glance. I will venture to say that he cannot tell, if his boiler is using water which has a tendency to form scale, whether the inside surface of his fusible plug is coated over with scale or not. I am venturing these assertions, knowing as I do the little regard which is paid to fusible plugs by the larger number of engineers, and I have an idea that Mr. B. L. C. isn't the exception. Because a fusible plug can be melted out it is not necessary to infer that the steam will be liberated by the pressure on the other side. It is no uncommon thing for an accumulation of scale to form itself on the metal sufficiently strong to stand the pressure upon it, and so prevent the liberation of the water and steam, and furthermore it does not take very much of a thickness of scale to do this. It has been found by experience that where the area of the plug is small a coating of hard scale less than 1-16-inch thick over a ½-inch hole, is sufficient to hold a pressure of from 70 to 80 pounds.

It is no uncommon thing to find boilers operating without any plug whatever, and those having plugs are not renewed as often as they should be, if dependence is to be placed upon them.

Mr. B. L. C. has evidently placed too much responsibility upon the safety plug, as he says that in placing a solid plug in the boiler head, I not only risked my own life, but that of many others. This statement strikes me as being rather rash and shows to me at least that he places more dependence upon the fusible plug than I ever have or ever will.

The fusible plug is nothing more or less than a very unreliable safety device and with a careful engineer or fireman, it is of practically no use whatever, because it will never have a chance to operate. Its function is not to protect the life of the engineer or fireman and those who are operating in or about the boiler room, but is for the purpose of protecting the boiler from injury in case the attendant allows the water to fall low enough to melt the composition, and that is all it is for. A man could allow his water to fall below the tubes and yet not cause any risk to his own life or those about the place, although such a procedure is not recommended, because it undoubtedly would weaken the boiler, but as far as an explosion taking place, I don't believe anything of the sort.

If I were to depend upon the safety plug as a protection to life I should certainly get my life insured, and furthermore to guard against any chance of the nature of the alloy to change I would renew the fusible plug every three or four months.

In case any of the readers of this letter want to know what a plug is composed of I give the following proportions for an alloy to melt at certain temperatures which is very commonly used.

7	part	lead,	1	part	tin,	4	parts	bismuth,	201	degrees	F.
5	"	"	3	"	"	8	"	"	202	"	"
2	"	"	3	"	"	5	"	"	202	"	"
1	"	"	4	"	"	5	"	"	249	"	"
1	"	"	0	"	"	1	"	"	257	"	"
1	"	"	1	"	"	0	"	"	466	"	"
0	"	"	2	"	"	1	"	"	334	"	"
1	"	"	3	"	"	0	"	"	334	"	"
0	"	"	3	"	"	1	"	"	302	"	"

In conclusion I want to say that I don't place very much reliance upon a safety plug especialy in a return tubular boiler of the horizontal type, and to prove my assertion I will say that I have one in a boiler at the present time which has been in for over four years and a half, and how much longer, I do not know. Now jump on me if you want to.

In B. L. C.'s case it is that of the pot calling the kettle black. What difference does it make what a man deceives about if he deceives? He says that no harm was done because no one knew the difference when he changed the gage on the steam line. Same in my case; no harm was done by putting in a solid plug, and I held my job because of it. One deception is as bad as the other. D. Parker.

Lead and Compression.

Editor of the Engineers' Review:

In the February number of the Review, F. Johnson, in commenting on a previous article by W. J. D. gives a few ideas on lead and compression which, though not entirely new, are at variance with the ideas, I think of a majority of engineers.

He says, "Compression reduces the area of the indicator diagram, proving conclusively that all compression, whether great or small, is a dead loss." True, it does reduce the area, but at the same time do not his cards show a reduction of the area of that part of the diagram showing steam admission? With compression the steam ports and clearance are filled with steam, but slightly lower in pressure than the steam line, while in the case of no compression these must be filled with live steam. Which do you think is the most economical?

Again, compression raises the temperature at the end of the stroke, and thus does away with the greater part of the condensation attendant on the admission of steam into the cylinder.

In regard to lead, I think a certain amount is necessary for the satisfactory operation of high speed engines, though no doubt there are a great many engines operated with entirely too much lead. As to noiseless operation, there is not, nor cannot be, any set rule. Every engineer must find out for himself just the right adjustment for his particular engine for even among engines of the same design and make there is sometimes a wide difference. F. B. B.

Cylinder Compression.

Editor of the Engineers' Review:

In your February issue on page 19, I note what F. L. Johnson says about cylinder compression. It appears to me in practice as well as theory, that a wide open port, as soon as possible after the center is found, is a decided advantage, and in order to get the full port as soon as possible we must have lead.

I also believe that an engine, especially a high speed engine will run smoother and with more economy with exhaust lead enough to insure good compression, but not enough to throw the valves from their seats as there is a limit to all things. I believe by getting exhaust compression we fill the clearance and it will take less live steam to do the work.

At one time I had charge of a Putnam, four poppet valve engine. The valves were lifted by cams and could easily be adjusted to suit the operator. As we were short of boiler capacity I experimented quite often until I obtained the best results, which was obtained by exhaust lead.

On page 22 H. J. says he would dress the edges of the packing rings. I don't think this is right as the steam has a tendency to press under and cause leakage. If the engine is in good line and enough of good cylinder oil is used, I don't think the engine will groan.

I have had knocking in cylinders caused by the rod packing getting hard, but by removing old and replacing with new everything would again run smoothly.

A short time ago I was in an engine room with the manager, when the engineer told him the engine did not get steam enough to do its work. The steam pipe was 1½-inch, exhaust 3-inch and the manager told the engineer to put in a 4-inch steam pipe. We see something new almost any old time. C. H. Prescott.

More About Compression in Steam Engine Cylinders.

Editor of the Engineers' Review:

The letters on compression have been very interesting to me, but I cannot agree with all that has been said. I feel that I am a good deal like one of your other readers who does not like the looks of the cards Mr. Johnson sent which were published in the February issue, as both of them show a late admission of steam, and although there is no doubt but that Mr. Johnson's engines run smoothly, I cannot see how he is gaining anything by reducing his compression to practically nothing, at the cost of his admission. In the March issue T. P. takes the trouble to measure up the high pressure card as to the area lost through the late admission of steam, also that gained by having a small amount of compression. He measures up the area as about .28-inch for the space lost by the late admission of steam while the area taken up by compression measures .33 inches. This according to T. P.'s figuring shows that the compression as he has outlined it is costing more, due to a larger area taken from the card, than the area of the space formed by the late admission line. He goes on to say that it is evident to every engineer that the compression as he shows it by the dotted lines, which is imaginary, is less than that found in practice by most engineers. I have measured the lines as shown in his diagrams in the March issue, page 32 which are as far as I can see identical to those in Mr. Johnson's article in the February issue, with the exception of the perpendicular steam line which has been drawn in, but I do not get the same results that he does, although this may be due to the fact that the cards may be reduced in size to what the actual measurements were made from.

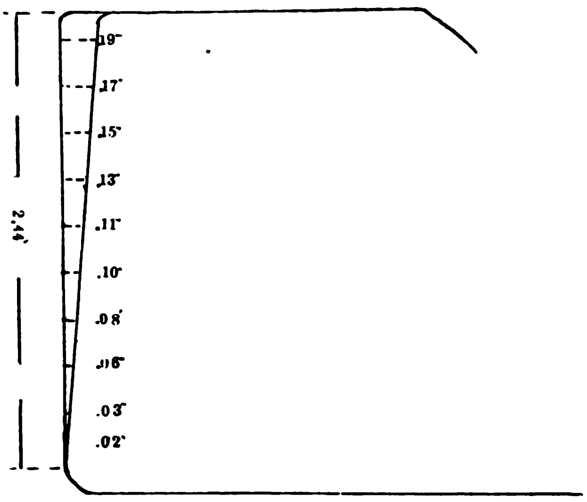


FIG. 1. AREA LOST BY LATE ADMISSION.

In Fig. 1, I have drawn a card, the admission line of which is drawn at the same angle as that on Mr. Johnson's card, shown in the February issue. By dividing the space between the horizontal and slant admission line into 10 divisions, I find that the length of the lines combined equal 1.04 inches. The height of the card is 2.44 inches. In order to get the mean length of the 10 ordinate lines, we divide their total length by 10 which leaves the length of the average line .104. This multiplied by the length of the diagram equals 2.44×.104 =.25376 square inches. This is the area that is lost from the imaginary card I have drawn, if the steam line takes the same slant as in Mr. Johnson's card.

In Fig. 2 I have attempted to draw what might be called an average compression line. The height being .83 inches. Dividing the figure formed by the compression line and a straight line drawn down and intersecting the back pressure line into 10 divisions, we find the length of all ordinates combined to be 1.44 inches. The average length is 1.44÷10=.144 inch. This multiplied by the length of the diagram is, .144×.83=.11952 square inches, the area that is lost from the card due to compression. This, however, is not accurate, because even in Mr. Johnson's card there is a trifle compression. But putting that part of the question to one side, we find in subtracting the area lost due to compression from that which is lost due to late steam admission, a difference between the two of .25376—.11952=.13424 which shows, if figures can be relied upon, that over twice as much area is thrown away due to the late steam admission as there is with the amount of compression generally carried.

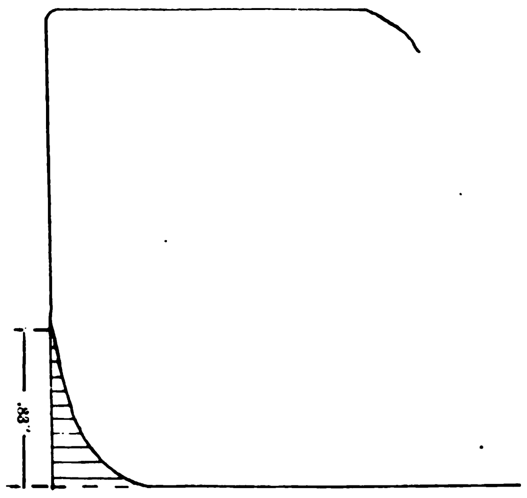


FIG. 2. AREA LOST BY COMPRESSION.

I have not exaggerated the drawings that I know of as I believe they look about the same as Mr. Johnson's card would if it were extended up on the same scale. From the above figures it goes to show, to me at least, that the compression could take up just about twice as much area as it does and still be as economical when it comes to the operation of the engine as the cards shown by Mr. Johnson would indicate. It will be found I think upon measuring the length of the top line on T. P.'s card and then measuring across at the same distance from the back pressure line on the diagrams I have enclosed, that the distance is practically the same and reducing the curve of the compression line to the same degree would bring it down to what is shown in Fig. 1 of his diagram.

I do not believe that any engine showing as late an admission of steam as the one from which the card Mr. Johnson produces would indicate, is running as economically as an engine having the steam line vertical, as it should be, and allowing the ordinary amount of compression. If my figures and idea are wrong, I will be much obliged to any one who will set me right.

W. Deming.

Believes in Compression

Editor of the Engineers' Review:

In the February Review F. L. Johnson says, " steam is used in the cylinder of an engine," to " turn the crank shaft," and again: " compression reduces the area of the indicator diagram," and still again: " All compression, whether great or small, is a dead loss. Lead, by introducing pressure into the cylinder when it can have no rotating effect on the shaft, is also a loss."

The first statement is granted, as it turns the crank all right, but the primary object is to convert the potential energy of the steam into kinetic energy at the pulley, and it depends on the valve setting, whether this is done efficiently or not. On the high speed engines a great deal of compression is necessary, while on low or medium speed not so much is required.

The right amount of compression will not cause a loss, because all the energy expended in compression will be contained in the steam in the clearance space and reduces the live steam admitted at the starting of the stroke.

If by " lead " he means early admission, I hold that steam should be admitted at the instant or a little before compression ceases, and the valve set to produce this effect whether any lead is required or not.

From the appearance of his low pressure card it appears as if his exhaust valve was leaking, possibly slightly open, because his steam line falls off before cutoff takes place.

One thing he says is O. K., however; that is if compression costs anything at all, it costs too much.

But the right amount of compression does not cost anything. John A. Coffman.

Mr. Johnson's Cards.

Editor of the Engineers' Review.

I thought I would write a line or two in regard to F. L. Johnson's idea of perfect indicator diagrams on page 19 of the February number. He did not state whether he was operating a tandem or a cross compound engine. If it is a tandem he can run as he says, but if it is a cross compound, I would like to ask him how he expects to balance the thrust of his low pressure piston on his crankpin without some compression. According to his cards he has a very light load.

Wm. E. Cline.

Governor Speeds.

Editor of the Engineers' Review:

A recent letter in the Review reminds me of the governor on the engine in the plant where I am employed. It is a 50-horsepower Atlas engine equipped with the Waters governor, and as it is a second-hand engine, I don't know how long it had been run before we got it.

When I first took charge of the plant I noticed when feeling of the crank and wristpins, it seemed as if the engine wasn't running steady, and when the load came on, the engine would fall off several revolutions before the governor would act.

Closing down one noon I examined the governor and it seemed to be working free. Then I took the sizes of my engine shaft and governor shaft pulley, and saw where my trouble was right away. The engine shaft pulley was 11 inches, and the governor shaft pulley was 5 inches in diameter. My engine was running 150 revolutions a minute and my governor was supposed to be running 275 revolutions a minute, which was the speed to govern the best. When I figured it out I found it was running 330 revolutions per minute. That showed that the governor was running too fast to act quick, as it was running 55 revolutions over what it was designed to, in order to give the best results in regulation. I figured out the sizes of the pulleys I needed to speed the governor to 275 revolutions as follows: Speed of the engine times the diameter of the shaft pulley, divided by the speed of the governor, which was 150x11÷275=6 inches the diameter of the governor shaft pulley. After I got the pulley and placed it on the governor shaft, my engine ran steady and the governor acts quick enough when the load comes on and there is no more laying down.

F. G. Van Orman.

Engine Pistons.

Editor of the Engineers' Review:

Years of experience in steam engineering has led me to believe that many engineers are notoriously careless about one very important part of their engine, that is, the steam piston. There is no part of an engine which should have more careful attention so that proper results may follow.

Many have an idea that if the piston does not knock out either head as it passes the center it is in its proper position. Then there are others who equalize the clearance on either end and call that correct. Both of these methods are simply guess work and I have concluded that there is but one right way to put a piston in the cylinder and have it correct.

The wall of the cylinder should be the stroke of the engine plus the width of rings out to out, minus ¼-inch. This will allow the rings a wipe over the counterbore, thus preventing any shoulder forming in either end. The above method, if followed, will always place the piston in proper travel, assuming of course that other connections are right.

I have found in some engines that little or no attention has been given to the location of the piston and cylinder as to the travel. Some manufacturers hold that the position of the rings in the piston is of little importance, that they can be placed most any way so long as they are steam tight; but my experience has been that a piston with rings, which did not wipe over the counterbore, caused a great deal of trouble sooner or later, and it takes more time to correct this difficulty than it would to have made it right in the first place.

The above is, perhaps, the opinion of but one man, but this opinion is formed from years of experience with many classes of engines. If any of my engineer friends believe that I am in error, I should be glad indeed to have them set me right. Yarled.

Piston Travel.

Editor of the Engineers' Review:

In looking over a couple of the late issues of the Review I came across several things which call for comment. Take for instance piston travel. Can it be possible that there is anyone calling himself an engineer who really thinks that taking up brasses will change the travel of a piston? It seems to me it is so plain that anyone ought to know that as long as the length of the stroke is not changed, the piston travel will be the same and the only way to change the length of the stroke would be to change the distance from the center of the shaft to the center of the crankpin. When you put in a ⅜-inch shim as Geo. Henderson calls it, you will have to regulate the piston head to even up the clearance in the cylinder, but the travel of the piston is still the same.

I am of the same opinion as C. B. Stockwell, engineers want something in engineers' papers that cannot be obtained in any other way. I would like to see all the able engineers write on something that would be of some benefit to us. When I come home from work and find the Review I never was so hungry yet as to prevent my looking at it before supper to see what it had new. Bill B. Banger, you strike right from the shoulder and you are all right. But, Bill, you should get your whiskers trimmed. W. W. D.

Is Satisfied.

Editor of the Engineers' Review:

On page 34 of the March number Mr. Wakeman again refers to the subject of clearance and travel. As I was the author of the letter he refers to, I wish to state that he is right in what he says. I meant as he says, one thing and said another or in other words I did not fully explain what I meant; but as he has done that to the satisfaction of all, I believe, so far as I am concerned we will let the matter rest. I like the gentleman's way of doing things and when he believes he is right to stick out for it. W. E. S.

Non-economical Steam Plants.

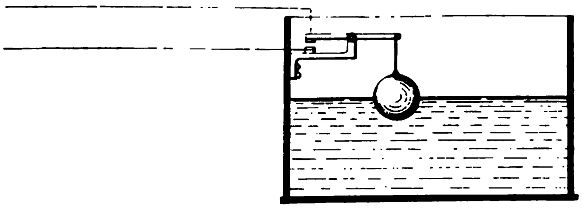
Editor of the Engineers' Review:

In the handling of steam plants, I find that a great deal of fuel is wasted, especially in plants where a large amount of steam is used for heating buildings that are built by the piece, *i. e.*, where new buildings are added and which are farther away from the boilers. It is often considered of no importance whatever to properly cover the steam pipes and return all water back to the hot well for using again.

In one plant I had, we built a small addition and heated it by steam. I found it hard to convince the owners that we ought to have a steam trap and pipe it to return the water back to the boiler. The one is a little expenditure at first; the other a continual loss as long as used.

The trap only allows the water to escape and keeps the pipes full of steam, while a valve regulated by hand either allows too much to escape or not enough and causes the pipes to fill up with water.

In some places where the water is not of the scale-making kind and no compound is used, it is not of so much importance to return the water to the boilers. Where you have scale to contend with, get all the return water you can and so get less scale and save the expense of using compound in your boilers. There are thousands of dollars wasted daily in steam plants not having good feedwater heaters or steam traps to care for the condensation and uncovered live steam pipes. Too little attention is given to the matter of leaky valves, packing rings, etc.



FLOAT AND CONTACTS.

In one plant of which I had charge we had three boilers which were crowded to the fullest extent, having to clean the fires as often as eight and ten times a day, as we were using a poor grade of coal. It took about a year to convince the firm that we really needed another boiler. They thought as we were then burning a lot of coal that we would use still more with an additional boiler. It meant, however, after we got the new boiler that we could allow our fires to burn longer without cleaning and a much slower growth of the ash heap was noticeable. It also meant that we could keep up the steam pressure so our engine would cut off at ¼-stroke instead of taking steam at full stroke, as it would most of the time, and best of all, we found a difference of nearly 10 tons of coal saved a month and a decided improvement of the temper of the fireman as well as of the engineers.

The wasteful way in which some plants use live steam is sometimes not fully realized. Many engineers have no idea how much steam can get away through a 1-inch pipe at boiler pressure, while often with a little extra piping, the exhaust steam could be made to do most of the work.

Another thing that keeps an engineer watching is when he has a tank on the roof. It is not easy to arrange a reliable registering device to prevent overflowing the tank. I have arranged a bell in my engine room that rings when my tank is nearly full by making an arrangement like the one in the figure. The water raises a float ball and makes a connection which rings the bell. A dry battery can be placed in the engine room and from it run a wire to the float and bell. This method hardly needs further explanation.

G. B. Warner.

Valve Wheel Kinks.

Editor of the Engineers' Review:

Most every boiler room has one or more valves which have to be operated every day and in order to do so the engineer is obliged to climb up on a ladder to operate them. This is especially true in winter weather when it is not safe to leave steam on a pipe all night for fear of its freezing up.

One way of getting a valve wheel down where I could get at it is shown in Fig. 1. Just why the valve was ever put in the position it is I am at a loss to understand and as it is a valve which is opened several times a day it was worth considerable to get up a device which would relieve me of the necessity of climbing up a ladder every time it was opened or shut.

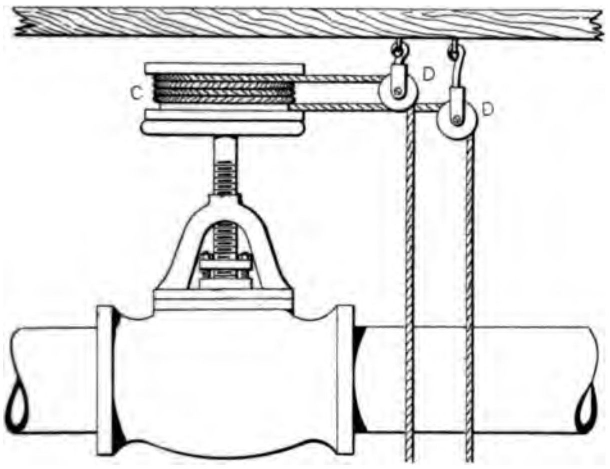


FIG. 1. KINK FOR OPERATING A VALVE.

As will be seen the valve wheel comes close up to the beam when open, and at the same time allows water to accumulate as the valve forms a pocket in that position as shown. In order to be able to shut and open the valve without getting up on a ladder I rigged up the scheme as shown in the illustration.

I got the machinist to turn up a flange wheel out of wood and bolted it to the valve wheel as shown at *C*, using ¼-inch bolts having the heads cut off and the ends bent in the shape of a hook. This was to lap around the arms of the valve wheel. Around this wooden wheel I wound a length of ⅜-inch rope giving it enough turns to allow of the valve being opened wide and closed tight without having the rope bring up on the part which was fastened to the wood pulley. In order to bring the rope down so I could get at it, and at the same time prevent it from running off the pulley. I rigged up a set of small pulleys as shown at *DD*. These were secured to screws and fastened to the overhead beam. The rope was endless and when I wanted to open or close the valve all that was necessary to do was to pull either one way or the other.

In visiting a pretty good designed plant I was impressed with the convenience of different apparatus such as valve stem stands for the condenser system, etc. It occurred to me as I went away that I could rig up something similar for my pump. We have a power pump which just about keeps the water level where it should be, but as the pump throws a little more water than is necessary the by-pass is opened occasionally to allow the water to fall to the proper level in the glass. The pump is located in the pump room which is on one side of the engine room and the boilers are on the other side. As there is a water column in the engine room it is not necessary to stay in the fireroom and consequently it is much more convenient to have everything regulated from the engine room.

When I got back to my own plant I began to work and finally hit upon the plan as shown in Fig 2. I made a rod to fit on the valve wheel as shown which extended through the wall to the space under the engine room floor. On the end of the rod a small beveled gear was fitted having a keyway in which a key was fitted to and made solid with the shaft, the gear wheel being free to move on the shaft and key. From the engine room floor, a rod having another gear which would mesh with the one on the horizontal shaft was adjusted and secured to the wall with small hangers made from bar iron. The vertical rod was held in place by means of collars, and on top of the rod was placed a good-sized valve wheel. After this was in operation the frequent visits to the pump by-pass were unnecessary as the valve could be operated from the engine room.

I. A. Bradley.

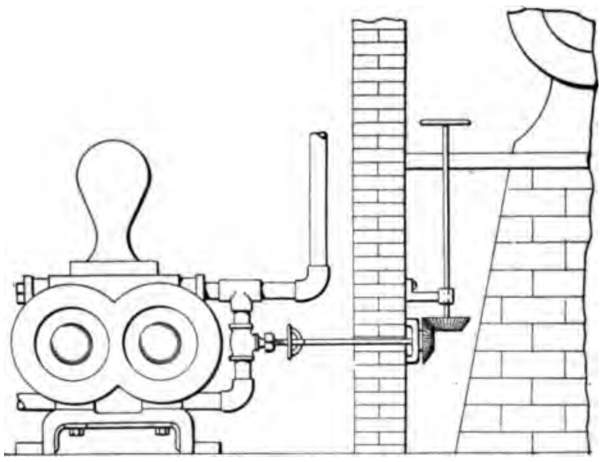


FIG. 2. A CONVENIENT WAY OF OPERATING A BY-PASS VALVE.

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure that can be exerted. The area of the water piston, multiplied by the pressure of water per square inch, gives the resistance. A margin must be made between the power and the resistance to move the pistons at the required speed—say from 20 to 40 per cent, according to speed and other conditions.

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FLOODING ENGINE CYLINDERS.

The flooding of engine cylinders is by no means uncommon and most engineers of one or two years of service have experienced this trouble. Although flooding is of frequent occurrence, the real reason is not fully understood, although many theories as to the cause have been advanced. Following is the probable cause as to the lifting of water in boilers having small steam space. It is well known that water in moving from all sides toward a common center at which it escapes does not move in a straight line, but approaches the outlet in spiral currents, while the velocity is in proportion to the quantity of water and the size of the outlet.

It would seem plausible therefore that the steam as it escapes from the boiler directly upward into the steam pipe, dry pipe or dome, acts in the same manner as does water in escaping from a tank. A whirling current of air will, in passing over water, pick it up and cause what is known as a water spout. A tornado also acts on the same principle. A whirling current of air will often be seen moving down a street picking up leaves and fine particles of dirt on its way. As the whirling steam forms directly beneath the outlet, and in a restricted area in many cases, there is every reason to believe that it picks up water in the boiler and carries it over into the engine cylinder, sometimes with serious results.

This theory is substantiated by the fact that boilers having large steam areas are not affected in this particular, and except in rare instances are free from priming.

HIGH STEAM PRESSURE.

There is nothing new in the statement that a high steam pressure is economical, but just what the economy is, is a point with which all engineers are not familiar. From theoretical deductions it would seem that between steam at 100 pounds and 150 pounds gage pressure there is an economy of about 18 per cent in favor of high pressure. If the pressure were increased to 250 pounds gage, a further gain of about 15 per cent would result, the difference between steam at 100 pounds and 250 pounds gage pressure making a total gain of about 37 per cent.

While these deductions are theoretical they serve to show the possibilities of economy in the use of high pressures. This is one of the reasons why modern practice tends toward the use of pressures, which only a few years ago were thought to be impracticable as well as dangerous and which prevented their use entirely.

The cost of operating a steam plant is a mighty lever, and the power it exerts will no doubt force the employment of high pressures up to the limit. There is a limit, of course, and it will be governed by two factors: The first and principal thing to be considered is the strength of the material and the workmanship which enter into boiler construction; second, the difficulty of properly lubricating engines using steam at very high pressures. There is no doubt that boilers can be made which will safely carry steam at 250 pounds pressure, for it has already been accomplished. Nor will the question of working steam at this pressure in engines constructed at the present time prevent its use. It is not at all unlikely that a steam pressure of 250 pounds will be in common use in the near future.

It should be said, however, that the greatest efficiency in the use of steam at this pressure is obtained in the triple expansion engine or the turbine.

A LESSON FROM THE BROCKTON EXPLOSION.

It seems that the only possible way to educate people along the line of safety to life and property is by some catastrophe such as the Iroquois theatre fire, the Slocum disaster or the Brockton boiler explosion which is fully described in this issue of the Engineers' Review.

The first two cases brought to light the fact that while laws had been enacted for their prevention the enforcement of the laws had been woefully neglected. In these instances it was possible to fix the blame on officials who had taken their oath to enforce the laws, and punish them for their neglect.

All the evidence taken at the inquest of the Brockton explosion, some of which covered not only this particular case, but many others, is to the effect that boilers, especially those 72 inches or more in diameter, that are constructed with the old style lap joint, are unsafe. It is a fact that is recognized by boiler manufacturers, boiler inspectors and engineers. These boilers are unsafe because it is possible for a crack like the one that caused the Brockton explosion, to exist without the possibility of discovery.

Boiler inspection laws that are probably the most rigid in existence, are in force and are enforced in Massachusetts. The boiler that exploded had been properly inspected and the law had been complied with. The coroners' inquest was unable to find any person or persons responsible for the disaster simply because it was due to a structural defect that it was impossible to discover.

The lesson then, that we should learn from this disaster is that a law should be passed in every state prohibiting the use of boilers of this type. No half-way measures should be tolerated. The law should be positive in wording and rigidly enforced. We know that it is difficult to pass such a law for there is an apathy among the masses, who know little of engineering matters, that is hard and almost impossible to overcome.

Everyone knows how difficult it has been to pass laws for the inspection of boilers and the licensing of engineers. In many states, although repeated attempts to do so have been made, they have failed. It therefore seems that some accident, awful and horrifying in its consequences, is necessary to frighten the people into making laws for their own welfare.

The state of Massachusetts is now continuing the good example, a more rigid bill on boiler inspection and operation having been introduced in the legislature. Its passage is being delayed in order to obtain the most expert opinions on these matters.

R. B. GROVER & CO. ASK TO BE DECLARED BANKRUPT.

Another result of the terrible boiler explosion of March 20, which destroyed the shoe plant of R. B. Grover & Co. and caused the death of 57 men and women, is the filing of a voluntary petition in bankruptcy by the unfortunate firm.

The assignment is made for the benefit of creditors to Chas. P. Hall, of the American Hide & Leather Co.; Judge Warren A. Read, of Brockton, and Fred B. Howard, vice president of the Home National bank.

WHAT TO DO IN CASE OF BURNS OR SCALDS.

Burns when covering large areas, require immediate medical attendance. In severe burns there is liability to shocks and prostration. The general directions for treatment of such a case would be to transport the patient to a place of safety, then remove clothing by cutting away with a knife or scissors. If the clothing sticks, do not pull it off, cut around it and wet it with water or oil, and promptly exclude air by covering the wounded or injured surface.

Care should be taken not to expose too large a portion of the surface to the air at any one time, and to cover as quickly as possible with something that will exclude the air. This should be done the moment the covering is removed. When the burn is extensive, expose and dress a small portion of the burn at a time.

Never hold the burn to the heat, but warm moist cloths are sometimes grateful, especially if wet with a warm solution of baking soda (bicarbonate).

When a person's clothing catches fire, make him lie down immediately or throw him down if necessary. Wrap him quickly in a blanket, cloak or shawl, preferably some woolen material, and smother the fire by pressing and patting upon the burning points from the outside. Have water ready, and in removing the wrapping pour the water over the burning point.

It is best in these cases not to attempt any dressing of the burns, simply to cover them with a layer of gauze, then a layer of lint, over this a layer of absorbent cotton, outside the whole a sheet or blanket, and await the arrival of the physician, or transport the patient to a hospital.

In slight burns or scalds, put a teaspoonful of baking soda in a pint of boiling water; stir well; in this dip a piece of lint and carefully cover the burns and scalded places; cover this with absorbent cotton, and finally wrap with the triangular or roller bandage.

In more severe cases, saturate lint with perfectly fresh salad oil, olive oil, sweet oil, vaseline or petrolatum. In the absence of these, the white of an egg may be used. A very common practice is to apply carron oil (equal parts of raw linseed oil and lime water). In absence of oils, dust the burned parts with starch, flour or toilet powder or if nothing else is available use moist earth or clay. Cover the whole with a layer of lint, over this a layer of absorbent cotton, and finally wrap with a triangular bandage.

Burns from caustic lye, strong ammonia and similar substances, should be first thoroughly flooded with water and then with vinegar, and subsequently treated as if burned by fire. Burns from acid, vitriol, etc., should be first flooded with water and then washed with a solution of baking soda or lime water. If nothing else is available, take chalk, tooth powder or a portion of mortar from the wall, crush it and stir it up with water and apply on lint to counteract the acid. After washing, treat as a burn by fire.

Use a weak solution of washing or baking soda in the case of drinking an acid. For other burns of the inside of the mouth or throat caused by drinking hot fluids or swallowing chemicals, apply oil or the white of an egg, by drinking, or pouring from a spoon. In the case of caustic potash, ammonia and the like, rinse the mouth and throat with weak vinegar.—*Exchange.*

Locomotives average a consumption of 3,000 gallons of water per 100 miles run.

QUESTIONS
OF THE HOUR

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.
The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

---

(413) A. L. J., Buffalo, Minn. Q.—"How many pounds of water is required per indicated horsepower per hour?" A.—There is a difference in the water consumption in both simple, noncondensing and condensing engines, for various points of cutoff. The standard engine performance cutting off at different points are given as follows. Cutting off at 1-10 stroke, the actual rate of water consumption with noncondensing engines having an initial pressure of 100 pounds, is 24 pounds; condensing 23 pounds. At 1-5 cutoff, with the same initial pressure the rate is, noncondensing 20 pounds, condensing 16.4 pounds. At ¼ cutoff, same initial pressure, noncondensing 20 pounds, condensing 17 pounds. At ½ cutoff the rate is, concondensing 25, condensing 24 pounds. With throttling engines the rate will be as follows: 35, 31, 31, 29, cuttingoff at 1-10, 1-5, ¼ and ½ stroke, respectively.

(414) C. S., Cambridge, Ohio. Q.—"What is the best style of dynamo to put in a factory for lighting purposes where the requirements will not exceed 50 16-candlepower lamps? Will a 3-kilowatt, 110-volt direct current dynamo answer?" A.—A small compound wound dynamo will give satisfaction. A multipolar machine is preferable as they are so constructed now that there need be no adjusting of the brushes from no load to full load. A 3-kilowatt machine will be large enough.

(415) Same. Q.—"Will I get satisfactory results by driving the dynamo from the main line shaft which runs at a speed of 240 revolutions a minute on the average, but which varies as much as 20 revolutions when certain machines are on? Which would be the best, a high or low speed machine?" A.—You will not get good light if there is as much variation in the speed as you mention. If you wish steady light the thing to do is to operate the dynamo by means of a separate engine of about 6 horsepower capacity. The speed of the machine will of necessity have to be between 900 and 1,200 revolutions per minute in order to obtain the voltage.

(416) M. L., Noble, Ill. Q.—"I am running an 80-horsepower Atlas engine having a wheel governor. In cold weather the governor will not work when starting up, until it has been warmed up, but it works all right in warm weather. Why is this and what is the trouble?" A.—It is quite evident the governor is sticking and the cause appears to be that the bearings have become gummed up with oil and dirt which prevents the governor from operating as it should in cold weather. In warm weather the oil is naturally thinner and the trouble is not experienced. Wash the bearings of the governor thoroughly with kerosene oil and then use a better grade of engine oil on the engine.

(417) E. A. S., Davenport, Ia. Q.—"We have two shunt wound dynamos connected in series and operating on the three-wire system. One set of brushes spark so badly that it is desirable to lift them and readjust them in order to finish out the run, and we have not been able to set them satisfactorily in the case without shutting down to do so. If after cutting in all of the resistance in the rheostat and then opening the negative circuit breaker what next is to be done before the brushes can be lifted from the commutator, and would it be advisable to open the field circuit? What is necessary to do in order to lift the brushes free of the commutator of any dynamo when in operation?" A.—If all of the brushes are to be lifted at once the fields should be cut out of circuit in order to demagnetize the fields and stop the generation of current. The armature may then be thrown out of circuit. If the brushes require adjusting while the machine is in operation it can be done by changing one brush at a time without cutting out the field coils at all. We would suggest that an examination of the commutator take place at once as there should not be such sparking as to demand the readjusting of the brushes during the run. If the machine is overloaded there seems to be but little remedy other than a new one.

(418) J. W. B., Gas City, Kan. Q.—"What is the greatest speed a one-ton balanced wheel will travel before going to pieces, providing it is cast all in one piece?" A.—The weight of a wheel has nothing to do with its bursting point. One might put 1 ton or 20 tons into a wheel, but both would rupture at about the same rim speed. It has been shown by experiments that wheels having whole rims will go to pieces when travelling with a rim speed of from 400 to 450 feet a second.

(419) P. G., Canonsburg, Pa. Q.—"Will it be possible to run two pumps from the same 4-inch suction pipe, supplying feedwater at a temperature of 210 degrees?" A.—There is no reason why two pumps cannot be operated from the same suction pipe if the pipe is large enough to supply the pumps. You do not say what the size of the pumps are, but if each has a suction pipe of 2 inches, the 4-inch pipe will be more than ample to supply both pumps.

(420) J. F. O'B., Los Angeles, Cal. Q.—"Please give me the information necessary to calculate the proper size of an air pump for a certain horsepower?" A.—The volume of the water cylinder required is found as follows: to the volume of condensing water in cubic feet, add the volume of the condensed steam in cubic feet and divide by the number of strokes of water piston per minute. Multiply this result by 2.75 for single acting and 4 for double acting.

(421) Same. Q.—"How is the size of a condenser found; both surface and jet?" A.—The size of a jet condenser varies somewhat according to the speed of the engine, but is usually made from 1-3 to 1-2 the volume of the steam cylinder. The quantity of the injection water required is from 20 to 30 times the weight of steam to be condensed, according to the pressure of the exhaust and the temperature of the water. For surface condensers a cooling surface of 2 to 3 square feet per indicated horsepower is found satisfactory in practice. The difference is due to the difference in the climate. The quantity of circulating

water may be taken at about 30 times the weight of steam to be condensed.

(422) F. G. F., Plankinton, S. D. Q.—"In your answer to question No. 402 in the February issue you say that a 2-kilowatt 110-volt exciter is altogether too small for a 75-kilowatt compound wound alternator, and that the proper size would be a 7½-kilowatt. This appears to me to be too large as it would mean that the machine would require 10 per cent of its capacity. I know of at least three standard makes of alternators which require from 1½ to 2 per cent for excitation and I have inserted an ammeter into the field circuit to prove the matter. Why should his machine require such a large exciter when the others require less?" A.—We do not know of any instance where a standard make of alternator requires as little as 1½ per cent of the output of the alternator. These must be exceptional cases. The rating assigned to the exciter is varied according to the experience of the makers in this line of work, and is governed partly by the conditions under which the alternator is to run, and partly by the convenience with which the different ratings of small direct current generators may be applied by the manufacturer to the case in hand. A machine with a large number of poles will require an appreciably greater excitement than a machine with a small number of poles. For instance a 150-kilowatt alternator having 12 poles would take a 2½-kilowatt exciter. In general practice the energy necessary to excite alternating current generators varies from 2 to 6 per cent, depending upon the particular design of the machine, and the condition under which it is to operate. In answering question 402 the answer was not intended to apply to every case, but to the one at issue. We can point out many cases where the exciter is rated at 10 per cent of the generator, although they are with the earlier types of the machine.

(423) J. R. B., Burlington, Kan. Q.—"Will you kindly inform me where I can obtain lead in small amounts such as is used in the construction of storage batteries?" A.—You will doubtless be able to obtain all you wish from The Electric Storage Battery Co. of Philadelphia, who have a western office in the Wainwright building, St. Louis, Mo. They will give you prices, etc.

(424) S. C. S., Chicago, Ill. Q.—"How is the velocity of the flow of steam calculated at different pressures?" A.—The following formula will give a close approximation and is found as follows: the absolute pressure in pounds, per square inch, multiplied by the area in square inches, divided by 70, equals the discharge in pounds per second. Another formula for computing the flow of steam is as follows: let

W = weight discharged, in pounds per minute; a = area of opening, in square inches; p = absolute pressure, in pounds per square inch; d = difference in pressure, when more than 58 per cent, and k = coefficient = 0.93 for short nozzle = 0.63 for hole in thin plate.

$W = 0.83\ a\ p$, when dicharging into the atmosphere..

$W = 1.9\ ak\ \sqrt{(p-d)\ d}$, when the difference between the two pressures are more than 58 per cent.

(425) Same. Q.—"How is the velocity of air through an orifice calculated at different pressures?" A.—We presume you have compressed air in a pipe. The flow may be computed from the following formula:

$Q = e\sqrt{\frac{p\,d^5}{W\,L}}$, in which Q = flow, in cubic feet, per minute; p = difference in pressure, in pounds, per square inch, by which the flow is caused; d = the diameter of the pipe in inches; L = the length, in feet; W = the density of the entering air, per cubic foot; and C = a constant coefficient. According to Halser, the value of C may be taken as =58.

(426) Same. Q.—" What is the difference in construction of an air pump from an ordinary boiler feed pump?" A.—In air pumps the piston-rod stuffing-boxes in the head of the air cylinder are sealed with water thus preventing any possible leak of air in through the packing in the gland to deteriorate the vulcanized rubber while the valves of the boiler feed pump are not so arranged. As a general thing the valves of the air cylinder are composed of specially vulcanized rubber while the valves of the boiler feed pump are made of a composition of hard rubber. The air chamber of an air pump is also provided with a priming valve.

(427) J. A. S., Hasley, Ore. Q.—" I wish to transmit from 4 to 6 horsepower from a shaft running 950 revolutions per minute to a shaft about 20 feet away and running at right angles to the driving shaft. Will a cable run at this speed, and how about the size of the sheave? " A.—There is no reason why a cable will not run from the shaft as well as any other kind of a belt. The thing to do is to keep the sheave speed below 4,500 feet per minute. If the shaft is revolving at a speed of 950 revolutions a minute the diameter of the sheave to put on the shaft would be 1½ feet. Such a sheave would have a circumference of 4.71 feet which multiplied by the revolutions per minute will be 950x4.71 = 4,466 feet, the speed the rim of the sheave would revolve. The cable of course would travel at the same speed. If a sheave of very much larger diameter were used there would be danger of its bursting due to centrifugal force.

WEAR OF WATER TURBINES.

Photographs of a 200-horsepower turbine which were recently on exhibition show a peculiar condition of wear. This turbine, from which the photographs were taken, has been in use for six years. It is of the horizontal type, and drives two 100-horsepower generators. The water is supplied under a head of 135 metres to the outside of the wheel, and at this point the size of the jet is limited by a sliding vane. The jet itself is divided into several independent streams by blades in the nozzle. All the blades of the wheel have worn away in the same manner. The extreme ends of the blades are but little affected, but toward the center there are three deep grooves cut entirely through the blades. The character of the wear indicates that it was not due to sand or foreign matter in the water, but to a peculiar action of the jet. Some authorities attribute the wear to eddies set up in the jet of water by the nozzle, and call attention to a peculiar erosion of rocks which is sometimes observed, and which is due to the eddies set up in the stream. It is thought that the action of the nozzle and the distributer is to set the jet of water into harmonic vibration, producing, in this case, several nodes and loops. This would produce the wear which was found to have taken place.—*Exchange.*

Cleaning of Fires.

The question is frequently asked of our representatives: "How often is it necessary to clean fires if your stokers are installed?" This is a question which may be answered very easily, but not in the manner that most people would expect. The best answer we have ever heard was given in the presence of one of our representatives by a colored fireman in the South who was operating the Jones stokers.

The operation of the stokers was being investigated by a professor of a local university, who asked the fireman, "How often do you clean your flues, Tom?" Tom replied, "De bes' way I can answer yo' question is to tell yo' a story.

"I use' to fiah on the Missi'ppi rivah. De Gov'ment use' to send a zaminah to zamine us fiahmen and find out what we didn' know. Dere was tree of us befo' de zaminer at one time. He says to John, 'How often you clean yo' fiahs?' John tol' him that he clean' his fiahs once in every fohty miles. Den de zaminah says, 'How often you clean yo' fires, Bill?' and Bill says, 'I nebah did know how often dem fiahs ought to be clean, I done wish you tell me.' De zaminah den says to me, 'Tom, how often you clean yo' fiahs?' I asked de zaminer if I could ask him question, and he says, 'Yes, go ahead.' Den I says to him, 'How often you wash yo'. hands?' and de zaminah says to me, 'Whenebah day duhty,' and den I says, 'Dat's when I clean my fiahs.'"

This answer is the only correct answer that can be given; and although stoker salesmen and coal dealers often make definite statements as to the length of time that fires will run without cleaning they are approximate only; as with any stoker or any method of firing the cleaning of fires depends entirely upon the class and quantity of coal used.—*Publicity Magazine.*

Tom's method is a good one to follow regardless of the type of stoker or grates.

Recent Tests of Steam Turbines.

A 500-kilowatt, continuous-current Curtis steam turbine set, erected at the Cork (Ireland) electric tramway and lighting system, was tested recently by Mr. Charles H. Merz, the object being to determine the steam consumption at different loads, these being, respectively, one-quarter, one-half, three-quarters, full and one and one-quarter of full load. The actual results in pounds of steam per kilowatt-hour were as follows: at one-quarter load, with 28.8 inches vacuum, 51 degrees superheat, and a steam pressure of 155 pounds, 24.9 pounds of water per kilowatt-hour. At one-half load the consumption was 22.64 pounds, the vacuum being 28.6 inches, and the superheat 51 degrees. At three-quarters load the consumption fell to 20.95 pounds of water, the vacuum being 27.9 inches, and the superheat 70 degrees Fahrenheit. At full load the consumption was 20.6 pounds, the vacuum being 26.9 inches, and the superheat 104 degrees Fahrenheit. The steam pressure had fallen to 153 pounds. At 25 per cent overload the consumption was 21 pounds of water, the vacuum being 26.2 inches; the superheat, 124 degrees; the steam pressure, 151 pounds. Correcting these figures so as to give the consumption corresponding to 28.66 inches of vacuum and 115 degrees superheat, the following are the results: at one-quarter load, 23.8 pounds of water per kilowatt-hour; at one-half load, 21.2 pounds; at three-quarters load, 19 pounds; at full load, 18 pounds, and at 25 per cent overload, 17.8 pounds.

During the first week in November, 1904, the trials of four vessels of the British navy, one of which has been equipped with steam turbines and three with reciprocating engines, were completed. The results were favorable to the turbine equipment, as they showed an economy over the reciprocating engines of about 23 per cent. Thus, the turbine, in addition to the saving in space, increases in the proportion mentioned the radius of action of the vessels equipped with it. This condition, however, obtains only when running at 18 knots. For a lower speed the reciprocating engines show greater economy. The best value obtained for the turbine was 13.8 pounds of water per horsepower-hour. This is with a speed of 20 knots. The consumption of the reciprocating engines for the same speeds was about 20 pounds.—*Electrical Review.*

The Largest Locomotive.

The Baltimore & Ohio road has just put in use the largest compound freight locomotive in the world. This is in use in the "pusher" service over Sand Patch Hill in the Allegheny Mountains. It is in fact a pair of locomotives with one boiler. The engine in working order weighs 334,500 pounds, and the weight of the tender, filled with 7,000 gallons of water and 13 tons of coal, is 143,000 pounds. This engine has the greatest heating surface ever put into a locomotive—5,586 square feet. Of this area, 219.7 square feet is in the fire-box, and 5,366.3 square feet in the tubes, the latter being 21 feet long. These proportions outdo anything of the kind ever before designed for a locomotive. The immense power of this engine may be conceived from the drawbar pull, which is 70,000 pounds, working compound; or 80,000 pounds, in simple gear. The boiler will carry a working pressure of 235 pounds.

Surface condensers should have about 2 square feet of tube [cooling] surface per horsepower for a compound steam engine. Ordinary engines will require more surface according to their economy in the use of steam. It is absolutely necessary to place air pumps below condensers to get satisfactory results.

Doubling the diameter of a pipe increases its capacity four times. Friction of liquids in pipes increases as the square of the velocity.

THE TOLEDO PIPE THREADING MACHINE.

One of the distinctive features of this machine is that the tool insures a taper which corresponds to the Standard pipe threads. It is a new device and the makers claim it to be a labor and money saver. It is also claimed that it will cut a thread on a pipe regardless of whether it is over or under size, without adjustment. This in itself is a point which should make it a favorite with those who are users of pipe threading dies.

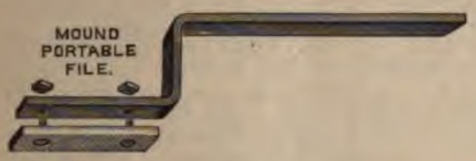
Each separate die is made to bear against a taper pin fixed in the stock, and as the dies advance along the threads, they are forced against the tapering pins, receding through the face of the stock and inserting a perfect thread. The dies can be changed quickly and easily, and there are no complicated parts to get out of order or become clogged up with dirt or chips.

The machine is made in three sizes. The smallest is shown in the illustration which threads pipe in sizes from 1 inch to 2 inches, inclusive. The second size takes a pipe from 2½ inches to 4 inches inclusive, and the third size from 4½ inches to 8 inches inclusive. The Toledo is manufactured by the Toledo Pipe Threading Machine Co., Spitzer building, Toledo, O.

TOLEDO PIPE THREADING MACHINE.

THE MOUND PORTABLE FILE.

This is something that requires little if any description as the illustration shows what it is. Every engineer can see at a glance just how convenient such a device would be in case the valve seats in a pump or engine which require attention quite often need smoothing up. Such a file should be a welcome addition to every engineer's tool chest. The Mound portable file is manufactured by the Mound Tool & Scraper Co., 710–712 Howard street, St. Louis, Mo.



MOUND PORTABLE FILE.

NEW CRANE VALVES.

The Crane Co. of Chicago have recently brought out and have applied for patents on improved renewable seat and disk globe and angle valves which are suitable for working pressures up to 250 pounds and are tested to 700 pounds pressure per square inch.

In the accompanying illustrations, Fig. 1 shows an interior view of the valve. The renewable parts are made of hard and superior composition. They are especially suitable for any hard work, where extreme pressure is used and where the wear and tear on the valve is most severe.

By unscrewing the nut on the bottom of the valve all parts are accessible and removable from the top, thus making it convenient to substitute a new seat or new disk when required, or to replace any worn part. The disk being attached to the stem by a slot, is easily removed and replaced. The seat and disk can be removed and the two ground together if necessary.

In putting the valve together, replace the seat, then tighten the nut on bottom of valve, which holds the seat in place; then screw on the bonnet and close the valve.

The construction of these valves is such that they may be packed when open without steam escaping; to do so have the valve wide open.

The Crane "self-packing" globe and angle and radiator valves, (patent applied for,) are made with Jenkins disk and non-rising stem and satisfactorily supply a demand for valves embodying this very desirable self-packing feature.

All users of radiator valves know that leaky stuffing-boxes are a source of a great deal of annoyance. The Crane self-packing radiator valves, illustrated in Fig. 2, have been thoroughly tested both as to efficiency and durability and fully obviate the trouble and annoyance caused by the escaping of steam and water.

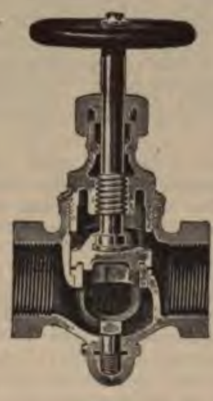


FIG. 1. SECTION OF GLOBE VALVE.

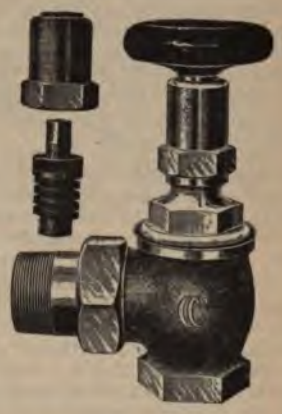


FIG. 2. ANGLE VALVE.

So confident are the manufacturers that these valves will meet all the requirements that they do not hesitate to guarantee entire satisfaction to all their customers.

NOTICE TO ENGINEERS.

An item of interest to engineers is the announcement by the Crandall Packing Co., Palmyra, N. Y., that they will send a fine engine-room clock to every engineer who orders 25 pounds of their packing. It is needless to point out the advantages of a reliable clock to any engineer. Many of our readers doubtless feel the need of a clock for their engine-rooms. They now know how they can get one. Use the coupon in their full page advertisement in this issue.

NEW BOOKS AND CATALOGS.

"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS," by Henry C. Horstmann and Victor H. Tousley, Frederick J. Drake & Co., Chicago, Ill., 1904, 157 pages, 6 x 4, 170 illustrations, soft leather binding, price $1.50. This book is very complete and comprehensive and is intended to supply working electricians and students with practical information which will assist them in electrical wiring. It takes up all classes of wiring, illustrating the methods used by means of diagrams which are most helpful. The subjects treated are bell calls and alarm circuits, fire alarms, electric lighting, power circuits, testing circuits; and shows how to connect all of the apparatus for this kind of work. Taken altogether, the book, with its drawings and text, should enable anyone who is only slightly familiar with electric wiring to do the work correctly.

SELF-PROPELLED VEHICLES, by J. E. Homans, A. M., Theo. Audel & Company, New York, 8vo, pp. 672, bound in black vellum, gilt top, gold titles, $2. In presenting the new edition of this work, the publishers announce that the book has been thoroughly revised, and in large part rewritten. The general principles of automobile construction and operation, including steering devices, underframes, wheels, tires, bearings, lubricators are included in the opening chapters. Then follows an account of the theory, construction and operation of gas engines, occupying over 100 pages. The explanations of the governing devices are clear and valuable, while the discussion of ignition, including the hot-tube, and the primary and secondary sparks, cannot fail to prove of the utmost value. Taking the subject of electrical apparatus from the fundamental principles of circuits and batteries, the discussion passes to the theory and operation of generators and motors. All necessary information is given, and the merits of several types of steam carriage are fully set forth. The book closes with a chapter on "Gasoline Vehicle Management," excellent for its completeness and "useful hints"; another on gasoline cycles that covers the general principles involved in this type of motor.

GAS ENGINE DESIGN by Charles Edward Lucke. D. Van Nostrand Co., New York; 254 pages; 145 illustrations; 6 x 9; cloth; $3. This volume presents in a compact form the principles which underlie the design of gas-engines, together with such data on the subject as seems reliable for the use of those in building gas engines, especially to those who are familiar with its characteristics. The book is concerned entirely with the quantitive side of design and treats solely of the forces in and the energy transforming power of the standard design of the exploding gas engine. Reliable data for reference regarding knowledge of the gas engine either of the probable output and economy or of the stresses in the proper strength of resisting engine parts have been met with difficulty. This volume on gas engine design contains data which represents the result of many years' collection and personal experience of the author. The work is divided into three sections, the first treating on the power, efficiency and economy and also gives the material necessary for deciding on the necessary piston displacements for any specified output for any kind of gas and enables the designer to approximately predict the economy. The second section contains data and method of determining the stresses in the parts and the number and arrangement of cylinders necessary for balance or turning effect to meet the specifications. Part three is entirely devoted to the dimensions of parts to resist the stresses both by theoretical analysis and by empirical formula, showing through what limits every principal dimension should lie. The results apply from the small high and variable speed automobile and boat engines, to 5,000 horsepower station engines; in fact the result applies to all classes of gas engines.

THE STEAM ENGINE, volume 1, by Robt. C. H. Heck, M. E., D. Van Nostrand Co., New York; 391 pages; 6 x 9; cloth; 190 illustrations; 10 tables; $3.50 net. This volume clearly sets forth the fundamental principles of the steam engine, giving a broad description of constructive practice and also explains the working of the steam engine in its several departments, and shows how to find its efficiency in performance. The volume is intended to be a text book for the use of students, but with this is coupled the purpose of making it a complete engineering treatise in which the theory of the steam engine is put into a form convenient for practical application. The volume is written for persons who have at least a few general ideas and facts regarding steam engines and who also have had a good preparation in mathematics, physics and mechanics, but all physical and mechanical reductions are built up in concise form from basal principles which renders the book nearly self-contained. The more elementary subjects carry full explanations, many examples being given to impress and elucidate principles. The advanced discussions are, however, more concisely stated, graphic methods are very generally used as being easier and clearer than algebraic. The matter treated is a general view of the subject of steam power plants, description of engine, valve movement and steam action and classification of steam engines. Chapter 2 treats on elementary thermodynamics of the heat engine. Chapter 3 is devoted to theory of the steam engine, while the action of the steam engine is taken up in chapter 4. Chapter 5 treats on steam jets and steam jet curves, form and influence of the nozzle, conditions beyond the nozzle and application of the steam jet. Chapter 7 is devoted to the mechanics of the engine treating on the force in the machine, motion in the engine, working force in the engine, force acting in the connecting-rod, pressure on the bearings, friction and efficiency and counter balancing. An appendix has also been added, containing tables for reference and notes on superheated steam. Volume 2, which will treat upon the form, construction and working of a steam engine, also the steam turbine, is now in press. It will be seen at once that the ground covered in these two volumes is more extensive than is even desirable for many courses of study.

FLOW OF STEAM THROUGH NOZZLES, by A. Ratu. D. Van Nostrand Co., New York; 74 pages; 5 x 7½; cloth; illustrations and plates; $1.50. This volume is a record of experimental researches on the flow of steam through nozzles and orifices, to which is added a note on the flow of hot water through nozzles. With the introduction of the steam turbine the engineering field is confronted with an entirely new series of phenomenon and the knowledge of steam accumulated by familiarity with the reciprocating engine is of little use in designing the steam turbine, the rapid advancement of which has necessitated the reinvestigation of steam from the point of view of velocity instead of pressure, of kinetic energy instead of potential, and of the friction of rapidly moving bodies against a vapor instead of a lubricated surface, as well as many other questions which are making themselves felt. Very little available data is at hand upon this subject and therefore the experiments undertaken by Prof. Ratu and the data accumulated by him should be of value to those who are interested in the study of this question. The volume not only contains an outline of the theory of steam flow, velocity and weight of discharge, profile of nozzle for steam and practical formula for discharge, but also gives the result of experiment with different nozzles. To add value to the treatise the different experiments are compared and a tabulated result of the experiments are produced. A discussion of phenomenon of the flow of hot water through nozzles is also entered into. The volume also contains an appendix which gives references to volumes and papers containing data upon the subject which will be of assistance to those who wish to study the subject further.

"THE ART OF GENERATING GEAR-TEETH," by Howard A. Coombs. D. Van Nostrand Co., New York; 129 pages; 6 x 3½; 34 illustrations; price, 50 cents. The theory of the action of gear teeth is one that has received considerable attention from various authors on mechanism and is of interest to mechanics and engineers. Usually this subject as treated in the technical press is condensed and not more than one or two machines are described, and it is doubtful if any comprehensive review of what has been accomplished in the invention and actual construction of gear cutting machines has been published. This little book contains six chapters, the first treating on the theory of tooth curves, to which 32 pages are devoted. Chapter 2 treats on the formation of gear teeth and 15 pages are devoted to the subject. Chapter 3, describes the first generating machines, while in chapter 4 is a description of American generating machines and chapter 5 is devoted to modern generating machines. Chapter 6 is devoted to a description of generating other formed teeth, such as the spiral gear, sager gears; also bevel gears to mesh with pin wheels. The book is of value to those interested in the subject.

A HANDSOME BOOK, containing 132 pages, of valuable data and fine illustrations on all kinds of pumping machinery has been prepared and is ready for distribution by Henry R. Worthington, 114 Liberty street, New York. It will be sent free to any engineer asking for Book W. 30 E. V., and stating where new pumping or steam apparatus is to be purchased.

A BOOKLET has just been issued by the D. T. Williams Valve Co., 904-906-908-910 Broadway, Cincinnati, Ohio, which illustrates and describes the Williams regrinding globe, angle and cross valves. Engineers interested in high grade valves will do well to get a copy of this booklet.

MERRILL'S IDEAL TWIN STRAINER is a device for catching all refuse in the condensing water and also provides a means for its removal without interrupting the flow of water or the maintaining of the vacuum at its maximum. This strainer, or fish trap, as it is called, is described in a folder sent us by the manufacturer, G. U. Merrill, 31 Van Houten street, Paterson, N. J. Mr. Merrill also manufactures the improved Tic-a-toc grease cup, automatic feedwater regulator, etc.

A HANDSOME NEW BOOKLET devoted to the interests of the National feedwater heater has been sent us by the National Pipe Bending Co., 175 Lloyd street, New Haven, Conn. This booklet contains much information regarding feedwater heaters and the heating of feedwater and will undoubtedly be sought by many of our readers.

"THE HABERKORN ENGINE" is the title of an attractive catalog recently received. The Haberkorn, which is a high speed engine, is built in several different types and has many points of interest which our readers will appreciate. This engine is manufactured by Haberkorn Engine Co., Fort Wayne, Ind.

GEO. B. CARPENTER & CO., 202-208 S. Water street, Chicago, who are the western agents of the Peerless Rubber Co., and carry in stock a complete line of their packing, belting, gaskets, etc, also carry a complete stock of the well-known Dixon flake graphite, graphite greases, pipe joint compound, belt dressing, paint, etc.

THE PHOENIX FLUE CLEANER, which the manufacturers claim is the most practical and satisfactory in the world, is described and illustrated on a card which we have recently received. The manufacturers, Hubbard & Co., Washington, D. C., also manufacture the Knox water tube cleaner which is for removing scale from the tubes of water tube boilers.

"MORE STARRETT TOOLS" is the title of the supplement to catalog No. 17, which has been sent us. This illustrates and describes a number of tools which will be found of interest to engineers. If you wish a copy of this catalog address the L. S. Starrett Co., Athol, Mass.

THE COLUMBUS GAS and gasoline engines, manufactured by the Columbus Machine Co., Columbus, Ohio, are briefly described and illustrated in a folder that has been received. Any one interested in the gasoline engine for any purpose should not fail to write for this company's catalog.

A VERY HANDSOME booklet containing about 16 pages, devoted to the American oil filter, has been received from the Burt Mfg. Co., Akron, Ohio. It treats the subject in a very satisfactory manner and leaves nothing to be desired in the way of information.

THE KEASEY PULLEY CO., Toledo, Ohio, have handed us their catalog describing the power transmission appliances which they manufacture. This catalog is a very handsome one and contains much valuable information on pulleys, hangers, counter-shafts, etc.

THE DUNHAM steam trap, which is said to be the smallest trap with the largest capacity in the world, is for sale by the Fisher Governor Co., Marshalltown, Ia. A folder which describes this trap in detail has been received.

A WATER TUBE boiler, which will be new to many of our readers, is manufactured by the Henry Vogt Machine Co., Louisville, Ky. Engineers interested in this boiler should ask for bulletin No. B 1.

"THE STEAM RADIATOR" is the title of a booklet published and distributed by Warren Webster & Co., Camden, N. J. This article is a funny description of an experience with a steam radiator in a hotel, and was written by Bill Nye.

PAYNE ENGINES, both simple and compound, which are manufactured by the Payne Co., Elmira, N. Y., are described and illustrated in a handsome bulletin which is known as No. 32.

A BOOKLET of about 85 pages, descriptive of the wire rope, cordage, etc., manufactured by A. Leschen & Sons Rope Co., St. Louis, Mo., has been received. This booklet contains much information of value to engineers and shows by drawings how to splice rope. Copies will be sent to all who write the manufacturers.

THE TURNER safety high and low water alarm columns, manufactured by the Binghamton Machine Tool Works, Binghamton, N. Y., are described in a circular recently received.

THE CATALOG of the Morris Machine Works, Baldwinsville, N. Y., builders of centrifugal pumping machinery, stationary and marine engines, has been received.

THE AMERICAN pioneer pressed steel shaft hanger is described in a handsome booklet which is distributed by the manufacturers, the Standard Pressed Steel Co., of Philadelphia.

REFRIGERATING AND ICE making machinery, manufactured by the D. LaVergne Machine Co., foot E. 138th street, New York, is described and illustrated in one of their handsomely printed bulletins.

THE MARCH ISSUE of "Graphite," a little magazine published by the Jos. Dixon Crucible Co., Jersey City, N. J., is very interesting and contains an article entitled "The Reduction of Load on Steam Engines." This magazine is sent free to all engineers who address the publishers.

AN INTERESTING and useful booklet has been published and is being distributed by the International Boiler Compound Co., 47 Market street, Chicago. It, of course, has something to say regarding the company's product, but that too is interesting. Several pages are devoted to rules and tables that are of use to engineers. A copy will be sent on request.

ANOTHER TUBE CLEANER for removing soot from boiler tubes and one that seems to bear the earmarks of a good device, is known as the Criss-Cross. It is illustrated and described in a booklet that we have received. It is manufactured by the Criss-Cross Tube Cleaner Co., Clinton, Mass. Mention this paper when writing.

ENGINEERS' CHUMS for 1905, a booklet issued by the Mound Tool and Scraper Co., 710-712 Howard street, St. Louis, Mo., is now ready for distribution. They have a new tool called the Mound portable file, which will appeal to a great number of engineers.

CRANE CO., Chicago, have just issued their advance circular describing Crane steam and oil separators, for the separation of water from live steam, and the elimination of oil from exhaust steam. Made in sizes from 1 to 30 inches, in the following types, horizontal, vertical, angle, and distributing. This circular contains 26-10½ x 13½ sheets, printed on white enameled paper, and handsomely illustrated from halftone engravings. It will be sent to the trade upon request. Please ask for "Advance Circular No. 01."

TRADE NOTES.

THE REEVES ENGINE CO., 85 Liberty street, New York, closed orders recently for a 16 x 16 horizontal for the Kansas City, Mo., City Hall; an 18 x 16 horizontal for the Sayville Electric Co., Sayville, L. I.; a 14 x 14 for the City Lighting Plant of Cedar Rapids, Iowa; a 6 x 7 vertical for the West Virginia Pulp & Paper Co., Tyrone, Pa.; two 12 x 12 horizontals for the Philadelphia works of George Hememant Co.; a 10 x 9 vertical for Swift & Co., Brooklyn, N. Y.; two 12 and 20 x 16 vertical cross compounds for Ben Stanley Revett, of Denver, Colo.; two 10 x 9 verticals for Farr-Alpaca Co.; a 16 and 26 x 18 vertical cross compound for the City Hospital at Philadelphia, and numerous others. Any one desiring a high speed engine for any service should investigate the Reeves.

MANNING, MAXWELL & MOORE, 85-87-89 Liberty street, announce that Mr. E. B. Boye has been appointed manager of their Cleveland office, which is located in the Williamson building, Cleveland, Ohio. Mr. Boye has, for the past five years, been connected with the Chicago branch. He is well versed and thoroughly posted on the various makes of machine tools and their uses, and they feel confident that he will, in his new position, increase his large acquaintance among machine tool users, and owing to his long experience in this line of business, they feel that his views will be of benefit to those purchasing tools.

RECENT SALES of the White Star continuous oiling systems have been made by the Pittsburg Gage & Supply Co., of Pittsburg, Pa., to the following concerns: Sibley, Lindsay & Curr Co., Rochester, N. Y.; Western Electric Co., Chicago, Ill.; Chicago Consolidated Traction Co., Chicago, Ill.; Northern Texas Traction Co., Handley, Tex.; Kremming Real Estate Co., St. Louis, Mo.; American Steel & Wire Co., Cleveland, O.; International Bank Bldg., New York, N. Y.; Wyoming Shovel Co., Wyoming, Pa. A careful test conducted by the Massachusetts Mills in Georgia, Lindale, Ga., power plant, where a White Star oiling system was installed May, 1903, developed the fact that by the elimination of hand oiling by this system on an engine doing 2,000 horsepower, about 75 per cent of the former oil consumption was saved this concern.

THE COMMERCIAL ELECTRIC CO., Indianapolis, Ind., announce that they are now installed in their new plant at Twenty-first street and Northwestern avenue. They are in a better position than ever to fill orders promptly and their shipping facilities are unsurpassed. They manufacture dynamos, motors and other electrical machinery.

ATLANTIC MILLS, Providence, R. I., have just received a 90-gallon Cross oil filter from the Burt Mfg. Co., Akron, O., making the fourth order which they have placed with this concern. These filters are said to be netting the Atlantic Mills a handsome saving on the vast amount of lubricating oil which they use.

THE EMERGENCY PIPE CLAMP for repairing splits and leaks in pipes, which is being placed on the market by the manufacturers, James McCrea & Co., Chicago, is certainly filling a long-felt want, as is shown by the number of orders they are receiving for them. There is hardly a jobber in the country that is not sending in his order for a complete stock from ½-inch to 4 inches.

THE CHICAGO OFFICE of the Crandall Packing Co., of Palmyra, N. Y., which was located at 30-36 La Salle street, has been moved to 52 W. Washington street, occupying a store on the ground floor.

WE ARE ADVISED by the Lagonda Mfg Co., Springfield, O., manufacturers of the well-known Weinland tube cleaners, steam and boiler room specialties, that they now have branch offices in the following places: Pittsburg, Iron Exchange building, Robert Gregory, manager; Philadelphia, Builders' Exchange, Jas. V. Davidson, manager; New York, 123 Liberty street, C. A. Gillett, manager; St. Louis, 511 Missouri Trust building, J. P. Maloy, manager. They also have selling arrangements at the following places: Chicago, The Chicago Engineer Supply Co.; San Francisco and Los Angeles, Chas. C. Moore & Co.; Toledo, O., Hardy & Dischinger Co.; Kansas City, Mo., E. D. Hornbrook; Peoria, Ill., Kinsey & Mahler; Indianapolis, Ind., Hide, Leather & Belting Co.; London, Eng., Selig, Sonnenthal & Co. This information is given for the benefit of the trade, so that anything needed in this line can be furnished promptly, and at reduced transportation cost from any of these points. The factory and general offices of the company are at Springfield, O.

AT THE ANNUAL MEETING of the stockholders of James Bonar & Co., Inc., held on March 27th, the following officers were elected: James Bonar, President; Isaac W. Semans, Vice-President; Joseph Cawley, Secretary; Richard J. Pollard, Treasurer. The same gentlemen were also elected directors. The statement of business for the past year showed a large increase, and the company reports a good demand for the various appliances which they manufacture. They have just gotten up a new catalogue which will be sent free to engineers upon request.

OUR REPRESENTATIVE had the pleasure of visiting the new plant of the Lippincott Steam Specialty & Supply Co., Green and Columbia streets, Newark, recently, and carefully looked through the company's facilities, and was surprised to see so many indicators, reducing wheels and planimeters being made at one time. This company intend to manufacture these instruments for sale, but up to the present time have been unable to supply the demands from the Indicator Instruction Co., whose students they supply with instruments for practice purposes. The additional facilities provided seem amply sufficient for the immediate future, and arrangements are made to largely increase these facilities should the rapid increase of business demand it. The Indicator Instruction Co. report a steady increase in the number of enrollments received, and our representative was shown applications for scholarship from students all over the United States and in many foreign countries as well, two from South Africa being recorded on the day of his visit. Our representative has been personally acquainted with Mr. Lippincott, general manager of these two companies, for several years, and was pleased to see so much progress being made. These companies will be glad to send literature respecting their work to those addressing Mr. Lippincott, general manager, at 93 Green street, Newark, N. J.

WANTED SALESMEN.

Wanted salesmen traveling among engineers to sell the France metallic and fibrous packings. Good inducements on unoccupied territory. France Packing Co., Tacony, Phila., Pa.

WANTED.

A practical engineer to buy my electric light plant; cost $9,000. Will sell for $5,000; $800 to $1,000 down, balance your own time, or will sell half interest. R. B. Foster, Burlington, Ks.

WANTED POSITION.

As chief engineer or mechanical superintendent of light station, stationary or locomotive work. Young; willing to work, strictly sober; not less than $125 a month will be considered. Address "Engineer," care Engineers' Review.

Engineer, 12 years' experience, wants position; Ohio license; best of references. Box 179 Edon, Ohio.

The Relief Valve.

Three little rules we all should keep
To make life happy and bright—
Smile in the morning; smile at noon;
And keep on smiling at night!

Old Inhabitant—I can remember when hogs ran loose on Broadway.

Young Inhabitant—They ride on the cars now.—*Puck.*

"It's rather peculiar," remarked Miss Caustique to me the other day, "that a young lady in society usually has to have a female chaperon until she can call some male chap her own."

Teacher—"What letter comes after H?"
Small Boy—"Dunno."
Teacher—"What have I on each side of my nose?"
Small Boy—"Freckles."—*Philadelphia Record.*

A woman friend of mine who has lost some money in mining stocks says there are three degrees of mining speculation, as follows: Positive, mine; comparative, miner; superlative, minus.

"Johnson wants to borrow some money of me. Do you know anything about him?"

"I know him as well as I do you. I wouldn't let him have a dollar."—*New Yorker.*

Farmer Skidmore (reading signs in a city hotel room)—"Gas burned all night charged extra." "Don't blow out the gas." These fellers is bound to catch you one way or the other.—*Cleveland Leader.*

"You are as full of airs as a hand-organ," said a young man to a girl who refused to let him see her home.

"That may be," was the reply, "but *I don't go with a Crank.*"

Prosecuting Attorney—"Was the prisoner in the habit of singing when he was alone?"

Pat McGuire (witness)—"Sure, an' I can't say, for Oi was niver with him when he was alone."—*Chicago Journal.*

Mrs. Smith—"Did ye hear 'ow Mr. Brown is gettin' on?"
Mrs. Jones—"I heerd 'e took a relapse this mornin'."
Mrs. Smith—"Eh, well, I 'ope it will do 'im good, but I ain't much faith in them new fangled medicines."—*Scraps.*

In a cemetery near Dublin the following words appear on a tombstone: "Here lies John Hurley, whose father and mother died while on their way home from America. If they had lived they would have been buried here."

Ascum—"I see there's some talk of having the people vote at the next State election upon the question of abolishing capital punishment. Would you vote to abolish it?"

Fogie—"No, sir! Capital punishment was good enough for my ancestors and it's good enough for me."—*Philadelphia Press.*

A man walking along a country road found an Irishman perched upon a signpost which pointed north, with the inscription: "This will take you to Malvern." "What are you up there for?" asked the man. "Faith," said the other, "I've been sittin' here for two hours, and I'm wondering what time it starts."—*The Children's Friend.*

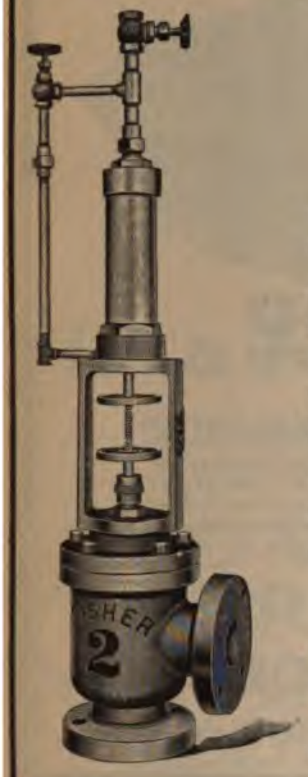
An old gentleman walked up to a pretty girl attendant at the counting room of a daily newspaper office a few days ago and said:

"Miss, I would like to get copies of your paper for a week back."

"You had better try porous plasters," she abstractedly replied; "you can get them just across the street."

A French lady is showing a visitor the family portraits in the picture gallery. "That officer there in the uniform," she says, "was my great-great-grandfather. He was as brave as a lion, but one of the most unfortunate of men. He never fought in a battle in which he did not have an arm or a leg carried away." Then she adds proudly, "He took part in twenty-four engagements."—*Selected.*

Save Your Steam



BY USING A

FISHER GOVERNOR

on your Steam Pump. Positive in its action. Prevents an over pressure in the tank or discharge main. For Hydraulic Elevators, Fire, Boiler Feed and any pump where the discharge pressure is to be regulated. If you want to know more about them write.

The Fisher Governor Co.
1202 Main St., West
Marshalltown, Iowa

You Can't Spend Money and Keep It

but you can buy

INTERNATIONAL Boiler Compound

which will pay for itself over and over again by keeping your boilers thoroughly clean.

We have a Special Offer for Engineers.

WRITE FOR IT.

International Boiler Compound Co.
47 Market Street, CHICAGO.

GALE'S
COMMUTATOR COMPOUND.
DIRECTIONS FOR USE.

☞ This compound is the only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING

Absolutely Will Not Gum the Brushes.

It will put that high gloss on the commutator you have so long sought after.

50 Cents per Stick. $5 per Dozen.

Upon receipt of this COUPON we will send you FREE a Sample Stick.

Name ....
Address ....
E. R.

FOR SALE BY ALL SUPPLY HOUSES
OR
K. McLennan & Co.
SOLE MANUFACTURERS
Inter Ocean Bldg., Chicago

READ OUR OFFER.

To Engineers:

This book is a treatise on present practice in the design of pumping machinery. It epitomizes sixty-five years of progress by the WORLD'S GREATEST PUMP MANUFACTURER, and describes a complete line of pumping, condensing and auxiliary devices for steam power station service.

No expense has been spared in preparing this book. It is printed in two colors, the cover is lined, and its 132 pages are filled with valuable data and handsome half-tone illustrations of Water Works, Fire, Mine, Boiler-feed and other Pumps, Jet and Surface Cendensers, Wet and Dry Vacuum Pumps, Air Pumps, Cooling Towers, Feed-water Heaters, Meters, etc. Interesting matter is also given concerning our new Turbine Pumps.

"Pumping Machinery" will be sent free to anyone asking for Book W 30 EV., and stating where new pumping or steam apparatus is to be purchased. Write to-day.

Henry R. Worthington,
114 Liberty Street, NEW YORK.

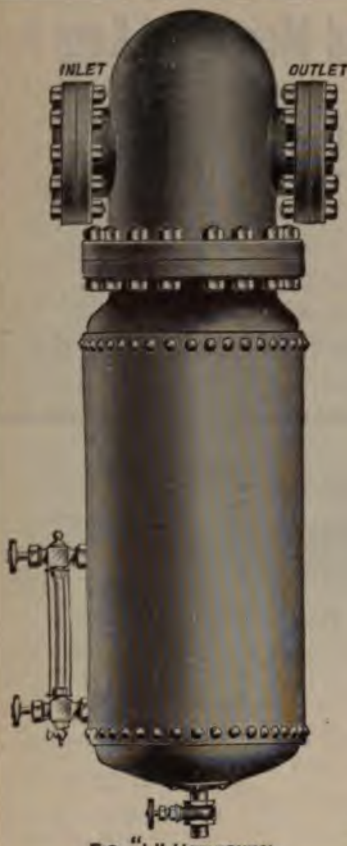


FIG. "L" HORIZONTAL.

The Purchaser of a Steam Separator

needs to discriminate with unusual care, for there are many makes and all bear the hackneyed label "The Best Made."

Each may be meritorious in one or more features, but sadly lacking in the complete make-up. Such separators soon prove detrimental to the user and he is forced to look for a better machine.

Now, if you, Mr. Reader, are contemplating the purchase of a separator, will you not carefully study the advantages offered by the extensive line of

AUSTIN SEPARATORS
FOR LIVE AND EXHAUST STEAM?

Remember, that we manufacture separators adapted for every condition of service. Based upon exact scientific principles, we can positively guarantee their efficiency as separating machines.

Our Steam Separators insure absolutely dry steam to the engine, smoother running, protection against water getting into the cylinder, and extra steam storage because of their large receiver capacities, so that extra steam is instantly available, close to the throttle, in case of a sudden increase of load.

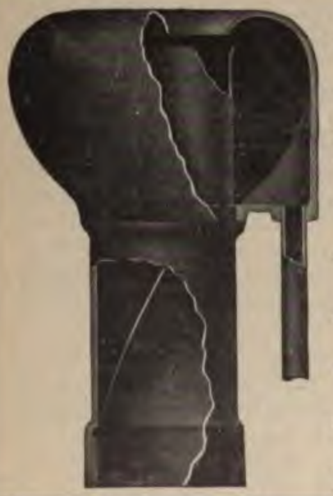
Our Oil Separators extract all oil, grease and other impurities from exhaust steam.

AUSTIN SEPARATOR CO.

90 Woodbridge Street, Detroit, Mich., U. S. A.

THE SWARTWOUT CENTRIFUGAL
CAST IRON
EXHAUST HEADS AND STEAM SEPARATORS

EFFICIENT SIMPLE ORNAMENTAL



The Swartwout Cast Iron Exhaust Head will neither wear out nor rust out. It is efficient and lasts a lifetime. Can you ask more?

The Swartwout Vertical Steam Separator is simple in construction and positive in its operation. Centrifugal force does it. Sold on trial to responsible parties.

The Ohio Blower Company, Manufacturers

CLEVELAND Dept. S-3 OHIO

Sales Agents for Wm. Bayley & Sons Company, Milwaukee, Wis. Manufacturers of Hot Blast Heating Apparatus, Blowers, Engines, Dry Kilns, etc.

In a Nutshell

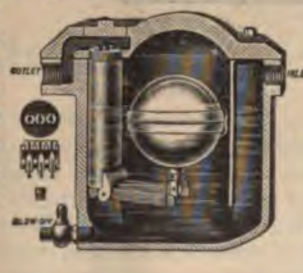
"A Wasteless Trap of Wonderful Capacity"

THE WRIGHT EMERGENCY STEAM TRAP

Wasteless because of a **double** water seal. Note in the cut below that this water seal is not a shallow affair, but that it is **constantly maintained** to a depth of four or five inches and covers **both inlet and outlet** of trap, locking it securely against escape of steam. Discharge does not take place until the water fills the trap to about two-thirds full.

Immense Capacity. — We base this claim upon the efficiency of our exclusive three valve principle. These three valves opening in succession with the rise of the float, insure a quicker disposal of sudden flushes of water than any other means. The three valves, or even two of the valves, operating at once will easily dispose of the largest inflows, though it seldom happens that more than the first, or center valve is required.

Other Advantages, such as ease of access to valves and valve seats by removing the plug over tube, location of valves at top away from scale and dirt, use of strongly reinforced high-pressure float, etc., are fully described in Catalogue. Ask for it.



Wright Manufacturing Co.

82 Woodbridge St., DETROIT, MICH., U. S. A.

This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

THE USE OF THE

Reliance Safety Water Column

INSURES, AMONG OTHER THINGS

Steady Water **Less Repairs**
Steady Power **Less Stoppages**
Steady Steam Pressure **Less Fuel**
Less Expansion and Contraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

WRITE US FOR FURTHER INFORMATION

The Reliance Gauge Column Co.
86 E. PROSPECT ST. CLEVELAND, O.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

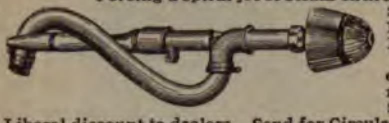
The Albany Steam Trap Co.
Albany, N. Y., U. S. A.
Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

THE FAMOUS PHOENIX FLUE CLEANER

Has Six Adjustable, Self-Sharpening, Interlocking Steel Blades with Bevel Edges. Doing perfect work even in spliced flues. Sent on trial and are delivered. All sizes, 2 to 6 in. **Hubbard & Co-** Washington, D. C.

Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.



Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. **Room 13, 74 Frankfort Street, CLEVELAND, OHIO,**

THE "LIGHTNING" TUBE GLEANER

Takes the Scale off QUICK inside and outside.

WARRANTED

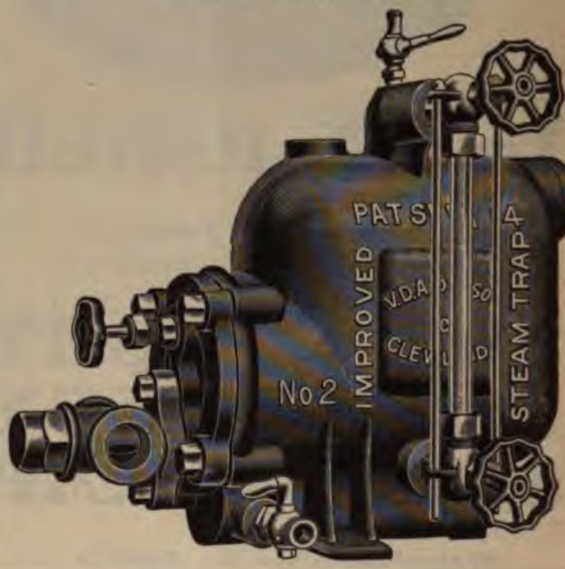
To do the work in less time.
To cost least to keep it in repair.
To save ⅔ your water bill for cleaning.
To operate successfully by air, steam or water.

SEND FOR 7 REASONS WHY THE "LIGHTNING" DOES THE ABOVE.

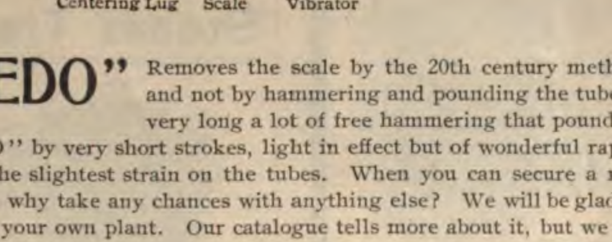
Manufacturers of Boiler Head Cap and Nut Reseater and Cleaner, Perfect Expansion Flue Brush and X-Ray Oil Filter, etc.

MAURER, LABADIE & CO.
215 ST. JOE STREET, SOUTH BEND, IND.
HUSTLING STATE AGENTS WANTED

The Standard Steam Trap of America
IS THE
ANDERSON
MANUFACTURED BY
THE V. D. ANDERSON CO.
CLEVELAND, OHIO.



Don't Pound and Hammer Your Tubes



THE "TORPEDO" Removes the scale by the 20th century method—the vibration principle—and not by hammering and pounding the tube. Boiler tubes will not stand very long a lot of free hammering that pounds and strains the very life of the tubes. The "TORPEDO" by very short strokes, light in effect but of wonderful rapidity, dislodges all the scale rapidly, easily, and without the slightest strain on the tubes. When you can secure a machine that will thoroughly and safely clean your boilers, why take any chances with anything else? We will be glad to send you a "TORPEDO" on free trial. See it work in your own plant. Our catalogue tells more about it, but we would prefer to have you try the machine itself. Write to-day.

THE GENERAL SPECIALTY CO., 73 Carroll St., BUFFALO, N. Y., U. S. A.

Try the Trimo

TRIMO on a pipe tool is a sure sign that it cannot be excelled for strength, durability and safety. Any Trimo user will confirm this; but we'd much prefer to have you prove it by test.

Strength

Trimo Tools are drop-forged from the best steel, and so designed as to give greater strength with less weight than any other tools. Every day use under the severest conditions had proved their superiority.

Durability

Trimo Tools are practically indestructible, owing to the great pains and high grade materials used in making them. All parts are interchangeable, and can be easily replaced at small expense.

Safety

Trimo Tools are designed with unusually large factors of safety. The utmost care is used in making every part of every tool, and in assembling the parts. Finally every tool is thoroughly tested before leaving our shops.

There are many other good points. It will pay you to read about them in our catalog

TRIMONT MFG. CO., Roxbury, Mass.

TRIMONT MFG. CO. ROXBURY, MASS. U.S.A.
No. 11

30 DAYS' TRIAL
TO PROVE OUR CLAIMS

Ruggles Perfection Flue Cleaner

will quickly prove its worth in any plant.

It is the simplest cleaner on the market—being made of two parts.

No screws or rivets used in its construction. Sharpens itself. Absolutely cleans the flue. It is strong and reliable.

Send for one on trial.

RUGGLES & RUGGLES,
Batavia, Illinois.

FOUR APPLIANCES
WITH BUT A SINGLE PURPOSE
ALL BUILT TO SAVE MONEY AND DO IT

FIRST THERE'S THE

Weinland Tube Cleaner

Gold Medal Winner at St. Louis, and winner wherever used. It's the cleaner the other fellows try to copy. We'll sell IT, or Power Driven Cleaners, or clean your boilers on contract.

TUBE CUTTER.

Cuts off tubes at any point—neatly, cleanly—without burr or bending. It costs little.

DAMPER REGULATOR

Controls damper in stack and stops waste.

RESEATING MACHINE.

Cleans header faces, nuts and caps quickly, perfectly.

The Lagonda Manufacturing Co.
SPRINGFIELD, OHIO.

"Boiler Cleaning Experts." "At it 20 Years."

NEW YORK, PITTSBURG. LONDON, ENG.

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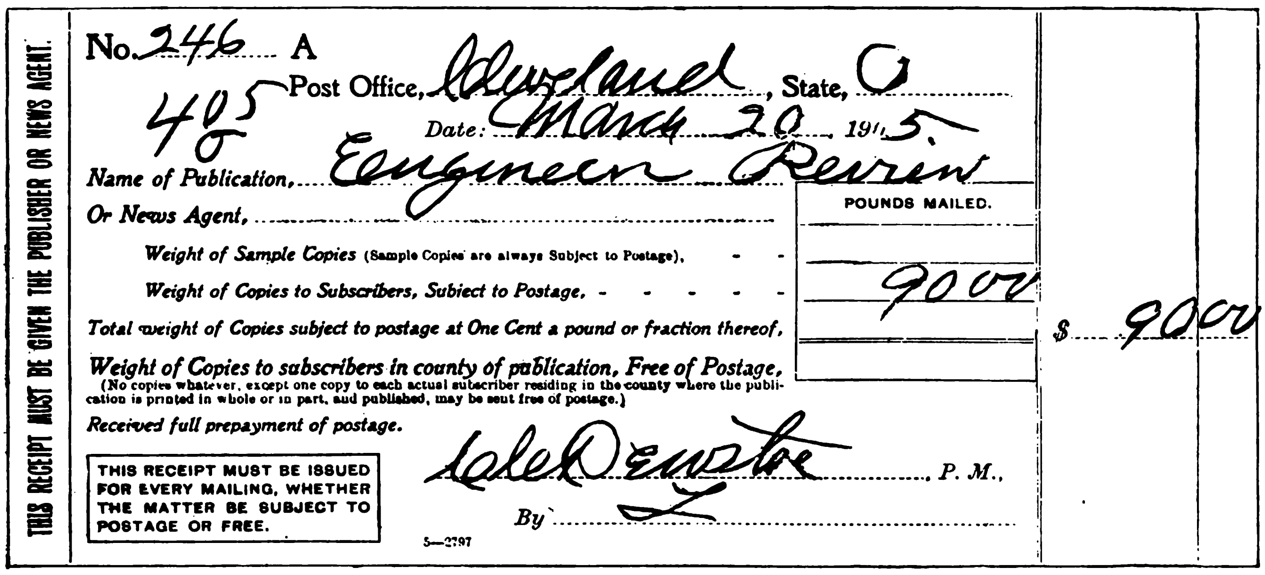
CRANE VALVES

Do You Want Proof?

Here is something for you, Mr. Advertiser, to think about. The Engineers' Review offers the only possible proof of circulation.



THIS RECEIPT MUST BE GIVEN THE PUBLISHER OR NEWS AGENT.

No. 246 A

405

Post Office, Cleveland, State, O

Date: March 20, 1905

Name of Publication, Engineers Review

Or News Agent,

	POUNDS MAILED.	
Weight of Sample Copies (Sample Copies are always Subject to Postage),		
Weight of Copies to Subscribers, Subject to Postage,	9000	
Total weight of Copies subject to postage at One Cent a pound or fraction thereof,		$ 9000
Weight of Copies to subscribers in county of publication, Free of Postage, (No copies whatever, except one copy to each actual subscriber residing in the county where the publication is printed in whole or in part, and published, may be sent free of postage.)		

Received full prepayment of postage.

C C Dewstoe, *P. M.*,

By

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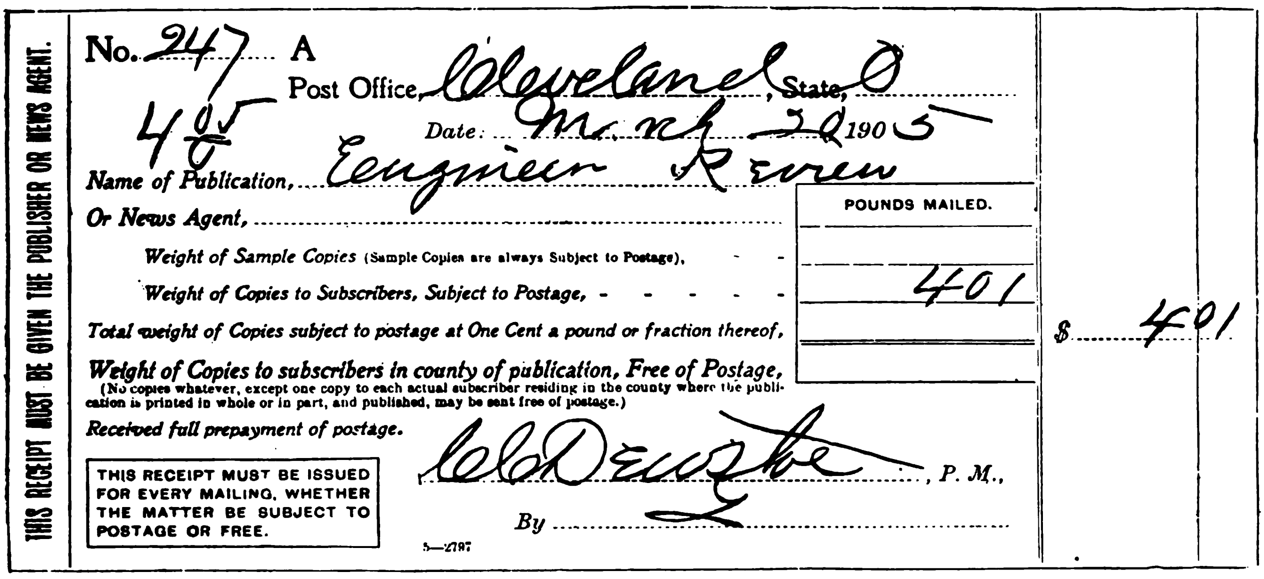
5—2797



THIS RECEIPT MUST BE GIVEN THE PUBLISHER OR NEWS AGENT.

No. 247 A

405

Post Office, Cleveland, State, O

Date: March 20, 1905

Name of Publication, Engineers Review

Or News Agent,

	POUNDS MAILED.	
Weight of Sample Copies (Sample Copies are always Subject to Postage),		
Weight of Copies to Subscribers, Subject to Postage,	401	
Total weight of Copies subject to postage at One Cent a pound or fraction thereof,		$ 401
Weight of Copies to subscribers in county of publication, Free of Postage, (No copies whatever, except one copy to each actual subscriber residing in the county where the publication is printed in whole or in part, and published, may be sent free of postage.)		

Received full prepayment of postage.

C C Dewstoe, *P. M.*,

By

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5—2797

Total number of pounds for March issue	9,401 pounds.
Deducting wrapping paper	150 "
	9,251 pounds.
One copy of March issue weighs 7 ounces, making a total number, mailed at pound rate, of	21,145 copies.
Copies mailed in Cleveland under stamps 250, and 305 delivered to our office make an addition of	555 "
The total edition for March being	21,700 copies.

A Whole Year's Subscription Free

To every engineer who will send us the coupon filled out, and a sample of scale from his boiler, we will send the Practical Engineer for one year free. The popularity of this paper is proven by the fact that its circulation is increasing thousands yearly purely on its merits. Possibly you haven't time, at present, to read a good paper like this. You would if you kept scale out of your boilers with

LORD'S BOILER COMPOUNDS

They will save you all the time you are now spending on extra repair jobs and coal shoveling resulting from boiler scale. If you want more time and less trouble and a first class engineer's paper for one year free, send in the coupon and sample of scale today. We pay the publishers of the Practical Engineer for your subscription.

The Geo. W. Lord Co., ____________190
2238-50 N. 9th St., Philadelphia, Pa.,

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, send me a certificate of analysis, and a year's subscription to the Practical Engineer free of charge.

Number of boilers in use ____________
Capacity of each boiler ____________
Frequency of cleaning boilers ____________
Frequency of opening the blow-off during working hours ____________
River or other source of water supply ____________
Boilers are used about ____________ *hours out of the 24*
Boiler compound now used ____________
Name ____________
Street and No. ____________
City ____________ *State* ____________
Firm's Name ____________
Eng. Review.

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Worthington, Henry R.

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Columbus Machine Co.

Alarms, High and Low Water
Crane Co.
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Arch Plates, Boiler
Lamprey Co.

Automobile Fittings
Lunkenheimer Co.

Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.

Belting
Carpenter & Co., Geo. B.
Chicago Rawhide Mfg. Co.
France Packing Co.
Quaker City Rubber Co.

Blowers
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Ohio Blower Co.
Snider-Hughes Co.

Boiler Compound Feeders
International Boiler Compound Co.

Boiler Feeders
Davis Regulator Co., G. M.

Boilers
Cooper Co., C. & G.
Harrison Safety Boiler Works.
Hays, Chas. N.

Boiler Tube Cleaners, Mechanical
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Pierce Co., Wm. B.

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Burners, Gas
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McCrea & Co., Jas.

Clamps, Steam Joint
McCrea & Co., Jas.

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Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Cocks, Gas
Pittsburg Gage & Supply Co.

Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.

Commutator Lubricants, Graphite
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McCrea & Co., Jas.

Cutters, Tube
Lagonda Mfg. Co.

Cylinders, Artesian Well
Myers & Bro., F. E.

Cylinders, Irrigation
Myers & Bro., F. E.

Dividers
Starrett Co., L. S.

Dry Kilns
Ohio Blower Co.

Dust Collectors
Ohio Blower Co.

Dynamo and Motor Brushes, Graphite
Dixon Crucible Co., Jos.

Ejectors
American Injector Co.
Chicago Injector Co.
Hancock Inspirator Co.
Penberthy Injector Co.

Eliminators
Hays, Chas. N.

Emery Wheels
Carpenter & Co., Geo. B.

Engineers, Piping
Best Mfg. Co.

Engines, Blowing
Buckeye Engine Co.

Engines, Gas and Gasoline
Buckeye Engine Co.
Columbus Machine Co.
Marinette Gas Engine Co.

Engines, Gasoline Hoisting
Columbus Machine Co.

Engines, Steam
Bates Machine Co.
Buckeye Engine Co.
Cooper Co., C. & G.
Ohio Blower Co.
Reeves Engine Co.
Russell Engine Co.

Exhaust Heads
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Flower & Co., Walter L.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.

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HAWKINS' ENGINEERS' LIBRARY

HAWKINS' INDICATOR.
HAWKINS' ENGINEERS' EXAMINATIONS
Hawkins' New Catechism on Electricity
Hawkins' Mechanical Drawing

LIST
1. Hawkins' Self-Help Mechanical Drawing, - - $2
2. Hawkins' New Catechism of Electricity, - - - $2
3. Hawkins' Aids to Engineers' Examinations, - - $2
(With Questions and Answers)
4. Hawkins' Maxims and Instructions for the Boiler Room, $2
5. Hawkins' Hand Book of Calculations for Engineers, - $2
6. Hawkins' New Catechism of the Steam Engine, - - $2
7. Hawkins' Indicator Catechism (a Practical Treatise) $1

NOTE:—When set is purchased, the seven volumes are supplied for $12.00, being a reduction of $1.00 from above list.

Send for Hawkins' Catalog. Note Monthly Payment Plan.

To Readers of Engineers' Review:

In again asking the attention of the Mechanical World to the Hawkins' Engineers' Library and the "little at a time" payment plan on which these books are supplied, the publishers wish to express their appreciation of the hearty support and endorsement tendered by those who have been and continue to be students of engineering.

The works are kept constantly "up to the times" by frequent revisions and additions by the author; to this fact is undoubtedly due their continued popularity.

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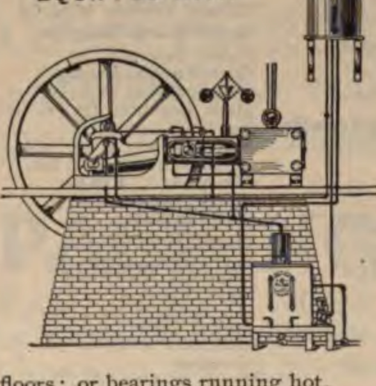

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(Continued from page 53.)

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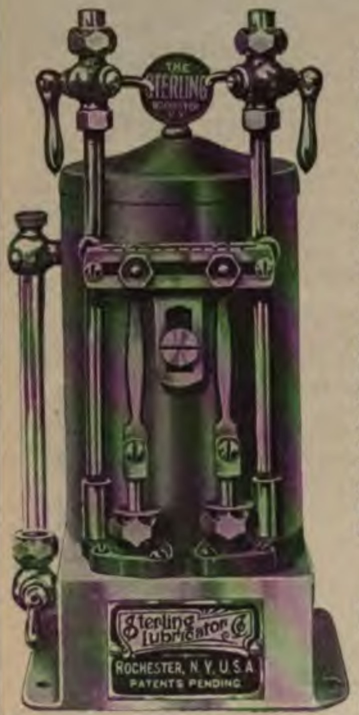

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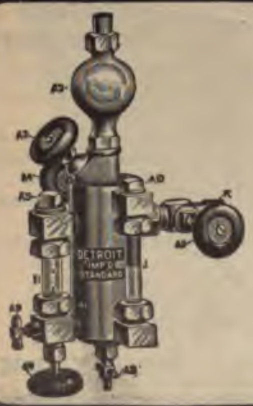

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Supplies Water to the Boiler at 212° F.

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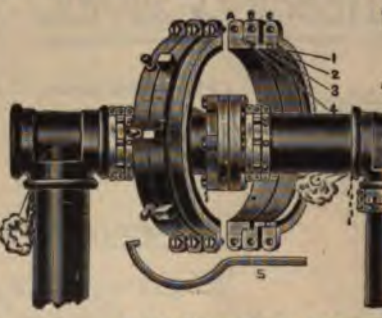

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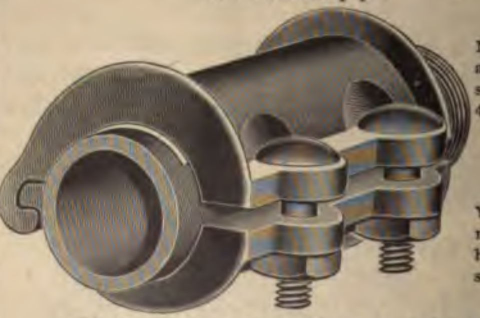

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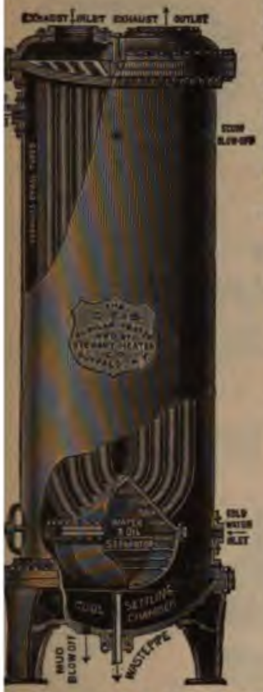

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Our Standard Heaters are Guaranteed

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Require less attention, fewer repairs and give better satisfaction than any other pump on the market on account of their

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Diameter of Steam Cylinders	Diameter of Water Pistons	Length of Stroke	Capacity	
			Boiler Horse Power	Gallons per Minute Maximum
3	2	3	100	20
4½	2¼	4	200	40
5¼	3½	5	350	70
6	4	6	500	100
7	4	8	600	125
7	4½	8	750	160
8	4½	10	900	175
8	5	10	1000	215
10	5	10	1000	215
10	6	10	1500	325

For hot water boiler feeding under high pressure, the MONITOR DUPLEX OUTSIDE CENTER PACKED PUMP, illustrated below, is especially desirable.

All water valves are located above the cylinders, so that vapors due to hot water do not enter the cylinders, which insures quiet operation. All valves are accessible through hand holes located on top of the valve chambers.

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Our prices will be interesting to you

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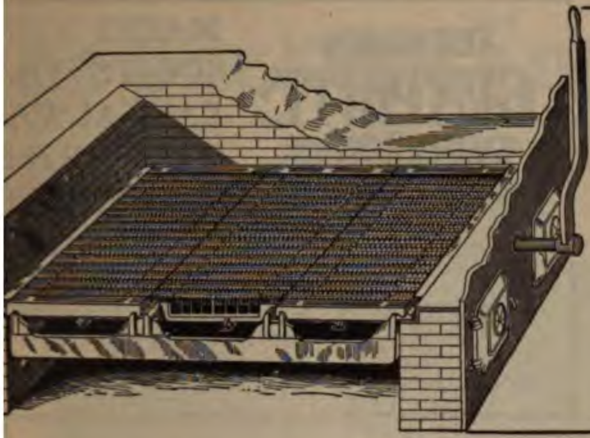

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Burns ANY fuel. Burns it ALL. Cannot choke, warp or clog. No fuel in ash pit. Adjustable for any size of fuel. A boy can operate it. Bars work together in shaking and openings are not enlarged. Has provision for expansion. Why not get our catalog and proposition?

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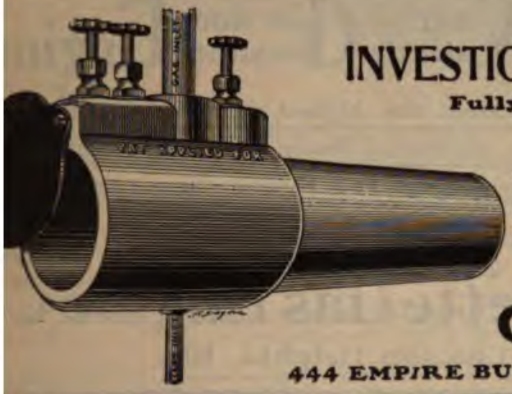

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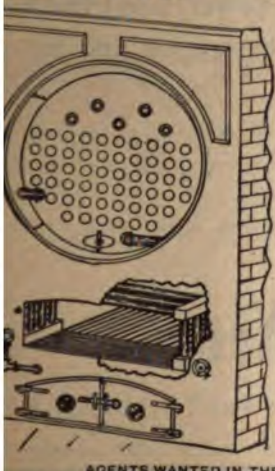

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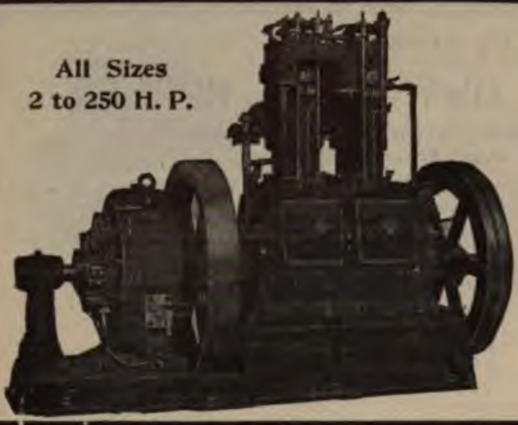

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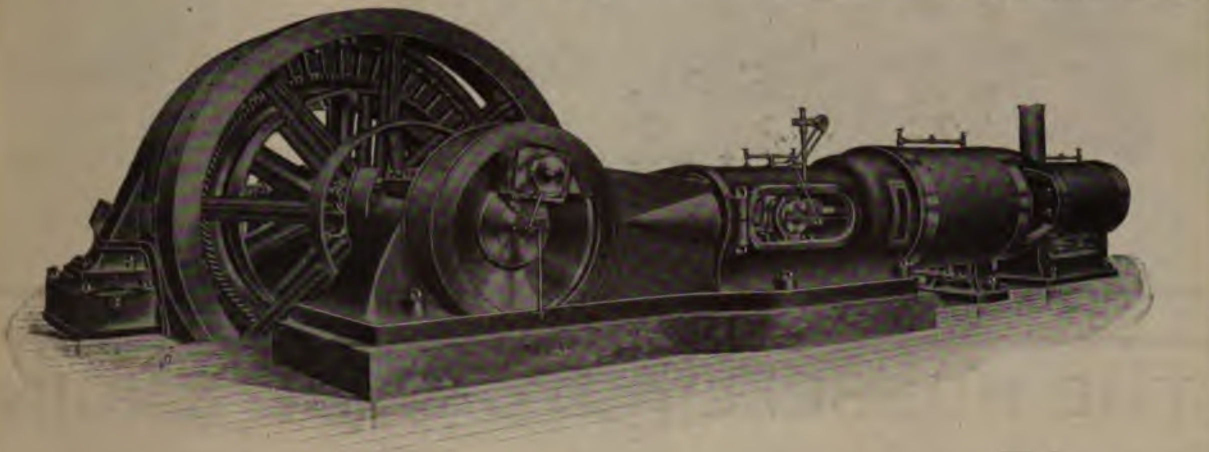

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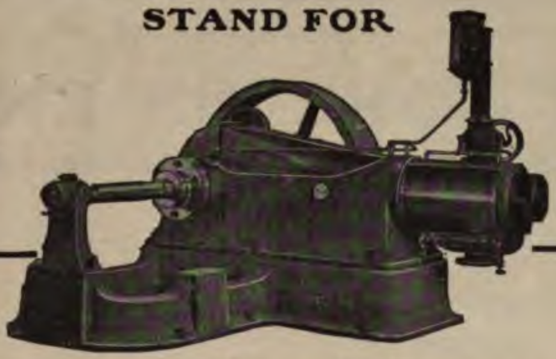

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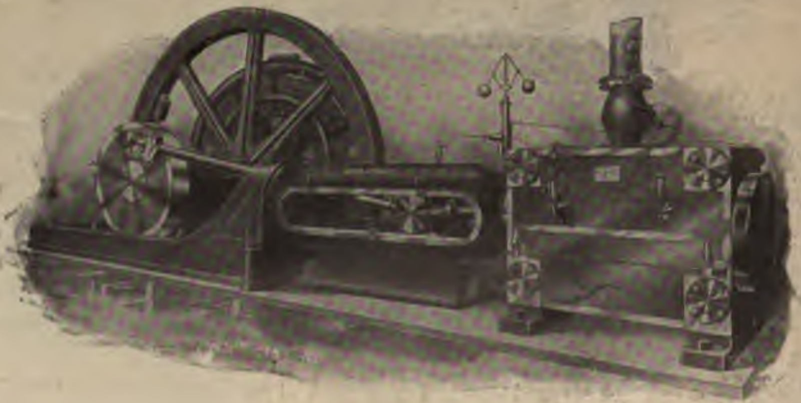

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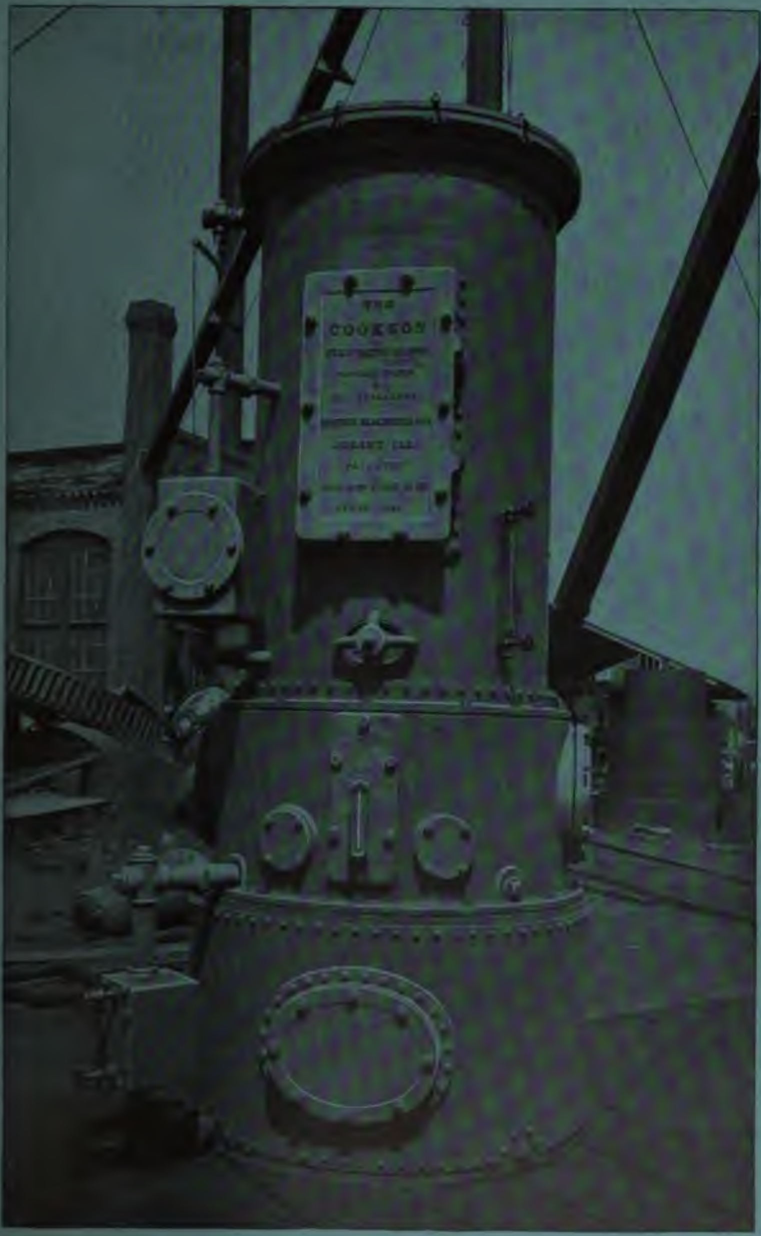

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Maintains higher temperature of feed water without back pressure on engines. Constant temperature 204-212° F.

Will heat more water with less steam than any other.

The steam only that is to be condensed comes in contact with the water.

Thoroughly purifies and filters the feed water.

Has more lime catching surface and filtering capacity than any other.

It is the heaviest, most durable, most reliable and most accessible to clean of any. Made of the best of materials throughout. Finest grade of fittings.

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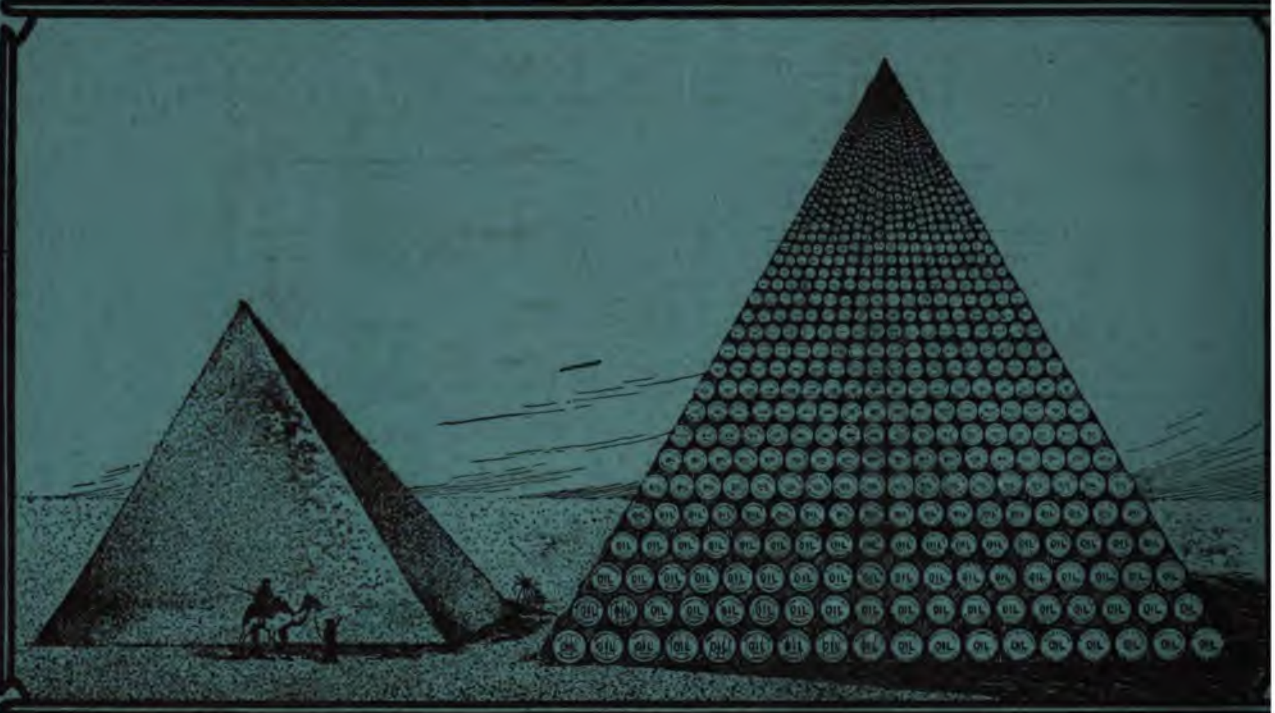

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ENGINEERS' REVIEW

Vol. 15
No. 5.

CLEVELAND, MAY, 1905.

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We also offer to send a barrel of Keystone Grease and eight Brass Grease Cups on ninety days trial—if not satisfactory, return to us and no charge.

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We rest our case on the above evidence.

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ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

VOL. 16. CLEVELAND, MAY, 1905. No. 3.

BOILERS AND FURNACES.

In selecting a steam boiler for almost any service, there are, providing the selection is made intelligently, such a multitude of questions involved and points to be considered that the layman is apt to wonder that any one man can master so many details. If the masses were more familiar with these questions there is little doubt but that the engineer who as a rule is nothing more to them than a greasy suit of overalls and a smutty face, would rise in their estimation.

First to consider is the type of boiler, *i. e.* tubular or water tube. Then, the type chosen, which of the dozen or more manufacturers makes the best boiler. In making this selection we must determine its style and workmanship, first cost and cost of installation and maintenance; durability; probable cost of repairs; water and steam capacity; its conveniences with reference to cleaning and inspection, both internal and external and so on.

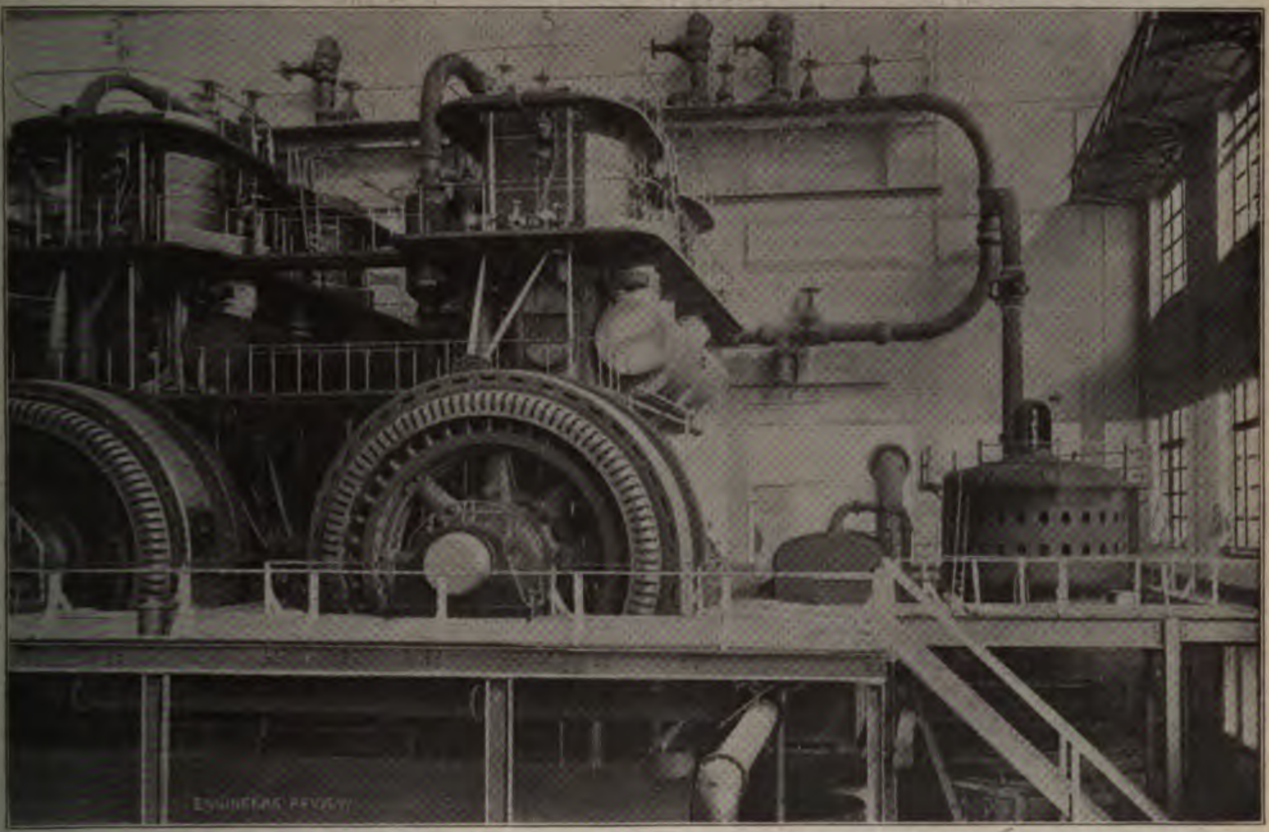
The specifications must also include the grate and heating surface, number of tubes and braces and their arrangement, thickness of shell, etc., etc.

As a safeguard, one should be sure that the specifications are carefully drawn up and are complete. If this is done there is something to fall back on in case the boiler is not satisfactory.

It is not our purpose to deal with these subjects in the order in which they are enumerated, but with regard to their relation to each other.

The economy of a boiler in the use of fuel depends more upon the kind of furnace used, the area of the grate surface and the arrangement of gas passages than upon the boiler itself with the exception that its heating surface is an important factor. These points being the same, one boiler will be as efficient as another.

The type of boiler to be purchased depends upon the conditions of service. For high pressures such as are used with compound engines, the water tube boiler is the safer and is as economical as the return tubular.



The modern power plant illustrated above is that of the New York Edison Co., New York city. The engine driven units have a normal rating of 3,500 kilowatts and operate at 75 revolutions. The Curtis turbine shown at the right of the illustration has been in service since October, 1904. It is of 5,000 kilowatt, 6,600 volts, 25 cycles and operates at 500 revolutions per minute. The generators are of the alternating type. The second and third turbine units are now being installed.

For ordinary pressures up to 120 pounds, the latter is as good as the more expensive boiler. The first cost is less and it will doubtless cost less for repairs than the water tube boiler.

The matter of durability and repairs are in a measure related to each other, as the less frequent the repairs, the longer the life of the boiler. In the return tubular boiler the tubes may be replaced when they are corroded or burned out and the shell can be repaired when it gets to leaking. Or if it becomes burned in any particular place a patch may be put on. When the shell becomes corroded badly a new plate can be put in place, but if the corrosion extends over the entire shell, it means the same as getting a new boiler. Of course a patch repair weakens the boiler. If the water tube boiler, when a section of tubes is in need of repairs, the whole section or part of it can be removed, and a new part easily substituted, thus making the boiler as good as new. In this type of boiler, the shell is not in contact with the fire and therefore is not in any danger of becoming burned. If a new type or style of boiler is being considered one should be careful to learn whether, should any repairs be necessary, they can be easily made and new parts secured. New companies spring up and if their boilers are not a success are apt to go out of business, leaving boilers which will be useless if any part gives out. This is more likely to be true of boilers that are built on freakish lines.

Every boiler should be so designed that mud and scale can be removed by some means or other, for the boiler is not made which will prevent the formation of scale, no matter how much circulation it will give if the feedwater contains scale making elements. The size and location of the man and handholes will depend upon the kind of water which is to be used. Sometimes a manhole is required below the tubes in the front end of the boiler head. At other times a handhole in the front head is all that is necessary, while in other cases it is advisable to place a handhole in the rear head, having the manhole either over the tubes in the rear head or placed in the shell on top.

It is also necessary to determine whether the grate surface is large enough to burn the maximum amount of coal expected to be used at any time, figuring on the available draft, the quantity of coal, together with its ash and whether the ash has a tendency to run into clinker. Another matter to be considered is the type of grate to be used, *i. e.* whether it is to be a stationary grate, some type of shaking grate or a mechanical stoker. Another thing to come up and puzzle the engineer is the construction of the furnace; will it be suitable to burn a certain grade of coal? With this comes the question as to whether the heating surface of the boiler is sufficient to absorb as much of the heat in the escaping gas as is necessary to keep it at a temperature which shall be reasonably low. This temperature should not be over 400 degrees F. with hard or anthracite coal, and 500 degrees F. with bituminous coal. The air passages should be of such design as to allow the gases to travel at a uniform rate the whole length of the heating surface of the boiler, and at the same time not be so large as to cause the gas to flow through by choosing the one with the least resistance. When these question are settled for any given boiler they will apply to any other type, providing the boiler and furnace are modern and properly designed. Each one of the above subjects should be taken up in detail by the engineer who has charge of the installation.

Large water or steam capacity has its advantages and disadvantages, the demand upon the boiler determining whether the work can be more easily done with a large steam space, or with a large water space. Large water space is useful where the demand for steam fluctuates greatly. In such plants it is desirable to store up the heat in the water while the boiler is not being operated hard, for use in case of emergency. Large water capacity is objected to however, in factory practice, especially when the boilers are banked for the night, and allowed to cool down, because there is so much water to be heated every morning before starting and so prevents rapid steaming.

The advantages of large steam capacity are often exaggerated. The principal claim for it is that the steam will be free of water before it escapes to the steam pipe, but the same result can be obtained from a dry pipe. As a storeroom of energy, it is of no importance, neither is it a means of equalizing the pressure during the stroke of the engine. There is a decided advantage in having a large water space *i. e.*, the water level changes slowly. A rapidly changing water level is apt to expose dry sheets or tubes to the action of the hot gases and so become a source of danger, while a rapidly rising water level may cause damage to the engine by being carried over, in case the fireman does not notice it in time to check the feed.

A positive and complete circulation of the water in a boiler is important. First, in order to keep all parts of the boiler at a uniform temperature, and second to prevent the adhesion of steam bubbles to the plate surface and so prevent overheating of the metal.

The faults which may show up in a boiler after it is put into operation are, low capacity, structural defects, and poor economy. Poor draft, insufficient grate surface, poor coal, furnace which is not adapted to the grade of coal being burned, defective brick setting, poor firing, bad water, and not enough heating surface are common causes for complaint.

The amount of draft required is a difficult problem to handle, as it varies so much in different plants. It depends to a great extent upon the type of boiler, area of the gas passages through the boiler and upon the style and area of the grate surface, as well as upon the coal burned.

The first noticeable effect of poor draft is shown in the inability to burn the coal, but in order to determine whether the draft or the coal is at fault, a test should be made. This is done by weighing the coal burned per hour for the period of time between one cleaning of the fires and the next cleaning, and comparing the amount of coal burned, with the amount, given from tests, which will evaporate a given amount of water. For instance if a boiler is required to evaporate 3,000 pounds of water, per hour and conditions exist which allow an evaporation of 8 pounds of water per pound of coal, then the coal burning capacity should not be less than 375 pounds during each hour between cleanings.

Starting the test with a clean fire, the coal consumed should be 375 pounds for each hour during the test. This average may be obtained by allowing 200 pounds of coal for building up the fire at the start and deducting a like amount for the last hour while the fire is burning down to the thickness that existed at the beginning of the test. In this way the first hour would edited with burning 575 pounds, the second, third fourth hours with 375 pounds each and the fifth with 175 pounds of coal, which averages 375 ds per hour for the first test. If the test shows that 475 pounds of coal were burned the first hour and :he second, third and fourth hours and 75 pounds ıfth hour it would be proof that there was insuffidraft for the kind of fuel in use. If the grates being choked up with clinker, the amount of coal ed each hour would reveal it as the amounts would fferent. Thus if 575 pounds were burned the first and 475 the second, 375 the fourth and 175 the it would show that the grates were being choked ashes and clinker.

ses of insufficient draft can in many instances be died by making a change in the construction or ection of the flue between the boiler and the chim- Such connections as right angle bends are very non, but they cut down the force of the draft, in cases at least one-half of that in the chimney. long easy curve is the most preferable and should sed when possible. It is a common thing for a to be put in operation with two or more boilers ected to the same flue, without enlarging the flue approaches the stack. This is a mistake which is made and which causes considerable trouble in nd.

hen the flue connections are not at fault the next dy is to increase the height of the chimney. Be- making any changes, however, it is wise to test raft with a draft gage. The gage should be cond to the flue at different points and also at each r in order to locate the point where the draft is sluggish. If it is not practicable to extend the ıt of the chimney and the chimney is not of suffiarea, the only remedy is to erect a new one. If himney is of the proper area, the defect of poor can be remedied by enlarging the area of the s, or in using a different kind of coal.

hen poor coal consumption can be traced to choked s the remedy is to put in some kind of a shaking , which will allow the ash and clinker to be ed out of the live coals into the ashpit without disng the fire to any great extent. This will in some increase the fuel burning capacity of the boiler ıch as 25 per cent, but there will be a loss of from o two per cent in coal, which will work through ;rates with the ash and clinkers. Good results been obtained by simply changing the grade of from a kind which will clinker to one which ıot. If coal which is of the clinker making kind be used, a change of draft will often be a detrito the furnace and lower the capacity of the ·, because when the fire is cleaned the strong draft such coal produces at first a rapid combustion, ı results in a high temperature and a fusing of linker. This soon obstructs the passage of air gh the grates and so checks combustion. It is nt therefore, that an enlargement of the grate ce and a slower rate of combustion for each e foot of grate surface will bring about a relief. me cases where clinker making coal is used it has found beneficial to allow water to stand in the t, thus causing a little steam to pass up through ;rate bars, which lessens the tendency to form :r. The water also helps to keep the grate bars which is necessary in order to preserve them.

Insufficient grate area combined with poor coal form a combination which will give trouble, so it is advisable to change the grade of coal when the boiler does not steam properly. A grate area which is not large enough with one kind of coal may give satisfaction with another. Coal which produces a large amount of ash and clinker cannot be burned with any degree of satisfaction with a poor draft.

Some of the faults of boiler settings that should be guarded against are, allowing the boiler and grates to come too close together, insufficient area through the tubes, or damper and other gas passages. An insufficient gas areaway tends to choke the passage of the gases, thus reducing the coal burning capacity of the furnace.

If in an evaporation test the boiler gives lower results than could be expected with the existing conditions, and at the same time the chimney gases are high in temperature, and there is a low rate of evaporation per square foot of heating surface, there are good grounds to suspect that the gas passages are of too great an area. This is not however, positive proof, as the same results may be caused by imperfect combustion in the furnace and the burning of gases in the gas passages between the furnace and the chimney.

Air leaks in the furnace walls are detrimental to the best results for combustion. These leaks are easily discovered by passing a lighted torch along all joints of the brickwork and stopping up all crevices where the flame is drawn in. Another way is to fire up with fresh coal and then close the damper, which will drive the smoke out through such leaks as exist.

When more air is supplied to the furnace than is necessary for complete combustion it tends to decrease the economy of the boiler. It cools the gases, decreasing the temperature between them and the water in the boiler, the difference of which governs the transmission of heat through the heating surface. It finally escapes at the temperature of the chimney gases, which causes a direct loss of heat. If sufficient air is not supplied to the furnace to thoroughly burn the coal, a slight air leak in the brick walls may be of actual benefit, as the air which leaks in may be sufficient to burn the unburned fuel gases in the gas passages. This is not intended as advice, however, for one should introduce the air into the furnace itself. If the furnace is well constructed there cannot be much loss due to air leaks.

Poor firing is often the cause of lack of boiler economy. The best method of firing is that which will cause no carbonic oxide, hydrogen, or hydrocarbon gases in the chimney gases and at the same time contain not more than 8 per cent of free oxygen. When combustible gases are present in the chimney, there is imperfect combustion, and consequently a loss of economy. It is impossible to do away with some free oxygen and from 5 to 8 per cent will be found a necessary accompaniment of complete combustion, but a greater amount of free oxygen means an unnecessary large amount of air, and consequently an unnecessary loss due to carrying the excess of heated air into the chimney.

Three varying conditions enter into this problem; the size of the coal, the thickness of the fire and the force of the draft. As coal does not come two cargoes alike in regard to size, there are really but two conditions which are under the control of the fireman, the thickness of the fire and the force of the draft. The latter is in some cases beyond his control, as when the plant is driven to its fullest capacity, and the draft in the first place is limited by the size of the chimney, the damper area, or the size of the gas passages. This condition ought not to exist as the chimney should be of ample capacity to handle a greater draft than is ordinarily required so that the draft in each or all of the boilers can be regulated by a damper.

If the draft is under the control of the fireman, good results may be obtained from either thin, medium or thick fires, providing the draft is regulated according to the thickness of the fire. Experience alone will determine what conditions will best apply to any particular plant. When two or more boilers are connected with a single horizontal flue leading to the chimney, the force of the draft will vary to a considerable extent, unless each is equipped with a damper. In some cases the draft cannot be regulated and the thickness of the fire should be varied according to the requirements of the draft. Here skillful manipulation of the fires is necessary.

Often a new boiler does not steam properly and an evaporation test should be made to learn exactly what the boiler is doing. If it has been guaranteed to produce 4 pounds of steam per hour for each square foot of heating surface, and it is not doing that, it will usually be due to insufficient grate surface or a deficiency in the force of the draft for the kind of fuel used. In such a case changes can be made so that the furnace will meet the demands. If, however, the evaporation comes up to the requirements it is evident that the boiler is too small for the work it is to do. Another boiler may evaporate nearly twice as much water per square foot of heating surface (a fact which may be borne out by a test), but it will be at the expense of the coal pile. The cost of coal, however, may be such that it is cheaper to waste coal than to buy another boiler. This can be done by increasing the area of the grate surface or increasing the force of the draft. This will force the boiler to produce the required amount of steam, but at a loss of coal. It is advisable in each case under consideration to make a series of tests to determine whether it is better to purchase an additional boiler or to force the present one.

In carrying out such a test under ordinary working conditions it will sometimes be found that no two of the boilers are driven at the same rate, and that by equalizing the draft one can effect an important saving in the fuel consumption, and at the same time it may increase the capacity of the boilers so much that additional boilers are not required.

In drawing up the specifications for a boiler the first points to be considered are the type and general dimensions, whether the boiler is to be of the overhang or flush front, the length of the shell and the diameter, and the distance of the heads from each other. The next will be the material, the thickness of which will vary according to the size of the boiler. The tensile strength of the plate should be mentioned, also the least allowable per cent of ductility, as indicated by the contraction of area at the point of fracture under test, and by an elongation of say 25 per cent in a length of 8 inches. The thickness of the heads must be specified and the process by which the boiler plate is manufactured, usually the open hearth system, the plates to be stamped with the makers name, the brand and tensile strength. Attention should be given to the method of riveting, the manner in which the holes are to be made, whether punched or drilled, the diameter and material of which the rivets are to be made, not forgetting to put in a restriction as to the use of the drift pin in any manner whatever.

The bracing will depend upon the size of the boiler, but one should specify whether they are to extend from one head to the other or from each head to the boiler shell or a combination of both; the size and diameter of the stays, the material of which they are to be constructed, and the spacing so as to bring an equal strain upon each brace, should be mentioned.

The tubes like the braces depend upon the size of the boiler and there can be such a thing as getting too much heating surface as well as too little. The tubes naturally depend upon the design of the boiler and when the design has been decided upon the number of tubes, their length and diameter are easily determined. Then comes their arrangement, *i. e.*, whether they are to be staggered, or set in vertical and horizontal rows. In spacing there should be not less than 1 inch between them in any direction. The central vertical space has in many instances been 2 inches and more wide, and has been found to be of much benefit in assisting circulation.

The number of brackets and wall plates must be taken care of, specifying their dimensions, the manner in which they are to be secured to the boiler and the number of rollers. There are usually two nozzles, one for the safety valve, and the other for the steam pipe connection, which are usually made of cast iron and riveted to the shell of the boiler. Other matters such as the smoke opening, the feedpipe, fusible plug, fittings, castings, grates, doors, bolts, etc., must all be specified, together with the boiler foundation and setting, smoke connection, damper regulator, blowoff pipe and other things which enter into the building of a boiler and its successful installation.

The location of boilers, usually receives but little forethought, the idea being merely to find room for them somewhere, somehow. It is not at all uncommon to find boilers located so that one side of the setting is also the side wall of the boiler house. This abuse of the boiler wall construction is carried so far in some instances that the sides of the boiler setting form both side walls of the boiler house. The only saving made by this practice is in first cost of brick, and this is soon overbalanced by the loss of heat radiated through the walls of the boiler house. In places where the price of land is so high as to prohibit the extension of the boiler house the above practice may be tolerated. But the side walls should be extra thick and the foundation laid upon broad thick footing stones, in order to prevent the walls from settling, which would eventually distort the front and back walls and affect the boiler support, as well as cause cracks through which air would leak into the furnace.

Then again the blowoff valve is necessarily on the outside of the boiler room and therefore exposed to the varying temperature of the seasons. This is liable to cause delays and accidents. If the valve does not leak it will freeze unless it has been boxed up, and if boxed up it is very inconvenient.

The boiler setting should be entirely separate from the walls of the boiler house and if there are a number of boilers there should be a sufficient thickness of wall een the furnaces, so that when one is being fired ther can be repaired if necessary.

ere must of necessity be a difference in the man- n which boilers are set up, bu tthis does not al- affect the economy of the boilers, or the cost of tenance. An engineer should be familiar with at three different styles of setting which have given results and from which he can study out a style h will be best adapted to his requirements.

ith the horizontal type of boiler, the matter of setting is of considerable importance, and partic- attention should be paid to the foundation in or- o obtain a good substantial base for the walls of boiler, and great care used to build them in a way that the expansion of the inner walls of g will not seriously affect the outer walls. If the are built with proper air spaces in them, both in ide and rear walls, beginning a little below the of the grate bars and extending as high as the ine, there will be little trouble from the difference pansion. The wall above the air space should be and bricks should be extended across the air at intervals to touch the inner wall. The interior e setting should of course be lined with fire brick, fifth course being a header or tie brick to tie the er to the main wall.

e method of suspending the boiler is optional. prefer to suspend it by means of eyes riveted to oiler shell, which are engaged by suspender rods, h pass up through, or between horizontal chan- which are supported by posts of metal after the on of the B. & W. water tube boiler. Another od is that of allowing the boiler to rest upon the work in the front and upon a pier in the rear, g a roller between it and the boiler to allow for ree expansion of the boiler shell. Probably the extensively used setting is that in which the boiler pported by means of lugs, riveted to the boiler which rest on the brick work. After placing the rest or plate, and the roll which comes between g and the plate, the boiler is free to move as it nds or contracts. There should, however, be no s under the lugs on the front end of the boiler ese lugs should be made fast to the brick work.

e combustion chamber with its floor sloping from ridgewall to the rear end has found favor with reatest number of engineers. It is convenient to has ample space and about the only objection to that it gets filled up sooner than it would if the m were as deep at the bridgewall as at the rear The combustion chamber should be cleaned out ery inspection and there ought not be enough ash o interfere with the economy of the boiler.

rnaces and boilers are now considered separately, rnace capacity and efficiency, and boiler capacity fficiency are two different elements in the prob- nd are not to be confounded.

ly a few years back 8 pounds of coal to each e foot of grate surface was considered about al and a coal consumption of 15 pounds repre- d forced firing. At the present time there are plants consuming from 20 to 25 pounds of coal ach square foot of grate area, when in regular e, and as high as 35 to 50 pounds when forced.

e height of the boiler above the grates has a good o do with the operation of a furnace and different s of coal require different shaped furnaces. For instance if hard or anthracite coal is used almost any kind of a furnace will give satisfaction. When bituminous coal is burned there should be a distance of from 2 to 3 feet allowed between the grates and the boiler. In some cases where very smoky coal is used 3 to 4½ feet is allowed and is not found to be too much. When a chimney emits great quantities of smoke it may be taken for granted that the furnace is not properly constructed, or that the firing is being done in an unskillful manner.

Insufficient heating surface is a serious matter and one which may not be suspected unless an evaporation test is made. It always causes a waste of fuel which may never be discovered if the boilers are not tested. Some engineers insist upon having the boiler which contains the greatest amount of heating surface, but there is a happy medium. Many cases can be cited where the steaming capacity of horizontal return tubular boilers has been increased by removing an entire vertical row of tubes. This so increased the circulation that the loss of the heating surface was more than made up. In any boiler, the amount and location of heating surface, circulation, draft and grate area must be figured according to their dependence upon each other, and no hard and fast rules can be made to govern the specifications of all boilers because of varying conditions.

Of course the greater the difference in temperature between the water and the furnace gases, the greater will be the transfer of heat and the effectiveness of the heating surface. When this difference is less than 200 degrees F. additional heating surface is of no account. Under these conditions the economizer becomes useful, but it in turn loses its efficiency if the difference between the water leaving it and the gases is more than 250 degrees.

A well designed furnace is the one admitting just the right amount of air. The furnace should be built of fire brick and so designed that the air and gases can mingle at high temperatures favoring complete combustion and where both are so cooled by contact with the heating surfaces, that they become useless.

No attention should be paid to the nominal horsepower, the number of square feet of heating surface being the most important if there is any expectation of crowding the boiler. When a boiler is rated as capable of producing so many horsepower, or evaporating so many pounds of water into steam from and at a certain temperature, the calculation is based on what can be produced from the best coal on the market, and not from what can be obtained from the kind of coal used in the average furnace. If a boiler rated under the best conditions of service were to have some kinds of coal burned under it, the rating would fall far below the average. For instance, a boiler burning slack, screenings, run of mine, pea, buckwheat or rice coal, will not come up to its rating, although the capacity is the same.

In every day practice each foot of grate surface will burn 24 pounds of good bituminous coal, 20 of anthracite egg, 18 pounds of pea, 16 pounds of buckwheat and 15 pounds of rice coal. The latter coal will require a draft of at least 7-10-inch, but should not go over 1 inch for fear of blowing fine unburnt coal from the grates with the ash. It has been determined that for each square foot of grate surface with the best bituminous coal it is safe to count 7.1 horsepower, 5.8

for egg, 4.4 for pea, 3.6 for buckwheat and 3 horsepower for rice coal. This shows that if a boiler is rated at 200 horsepower with the best bituminous coal and a change is made to buckwheat, it cannot produce much more than half the horsepower unless the grate area is doubled, although the rating of the boiler remains the same.

As there is a limit to the length of grate which a fireman can handle we have to consider the question of width and to obtain the proper amount of heating surface, we must have a low broad boiler for the low grade anthracite and a high narrow boiler for the high grade bituminous coal.

The superiority or inferiority of one furnace over another is due to more complete combustion in the first case and escaping hydrocarbons and incomplete combustion in the second case, although the air supply may be the same in both cases.

The size of coal has an important effect upon furnace capacity and all other conditions being the same, may affect the result as much as 50 to 80 per cent.

STEAM PLANT PLANS.

The supply of electric light to small cities and towns is usually produced in one of two ways, *i. e.*, either by the continuous current or the alternating current system. When the continuous current system is employed it is at a low tension of from 110 to 230 volts, and the dynamo is frequently assisted by storage batteries at the peak of the load, by being connected in parallel. With this arrangement the storage batteries can be charged during the time when the load is light and be ready to assist the dynamos in case of a sudden demand upon them, when perhaps only a portion of the plant is in operation.

The problem of running wires to the various portions of the town is one which has a good deal to do with the future success of the plant. It should be known that to transmit the same energy the same distance with the same loss due to resistance, the size of the main, can with the higher voltage be reduced to about one-half the cross section of the wire used with a low voltage, or, with the same percentage of loss the mains may be reduced to one-quarter of the full size. This is the same as saying that either four times the lighting can be done in the same distance or the same amount of lighting can be done at four times the distance. Systems which are supplied with a low tension current of 110 volts can be carried for a distance of about one-third of a mile from the generating station, but beyond this radius the mains must be made large or the percentage of loss becomes so great as to reduce the economy of the plant.

When operating with the alternating system, the current is at about 2,000 volts and is reduced to the required voltage by means of transformers. This is a very flexible system for transmitting electricity to distant points, but it has its faults, for although in using the high tension system the mains may be reduced to any required section, and the loss due to fall of pressure is minimized, the losses in transformers in lighting a large area may be considerable during the hours of light load.

Although by adopting the alternating system a large saving of copper can be effected in the feeding mains, much greater precautions must be adopted than with the low tension current, and these precautions involve a greater outlay. This, taken together with the cost of the transformers, renders the alternating system less suitable for lighting territory near the lighting station, than the low tension system.

Depreciation of the plant is also a subject which must be considered, and it is evident that the depreciation of the high tension system with its transformers will be greater than with the low tension system, especially if bare copper wire is used in the latter.

Several volumes might be written on the electrical end of the power plant, but as we are more interested in the steam engineering department, will therefore discuss that important subject.

In taking up the construction of a power plant we are confronted with two facts: the building is frequently too small and is rarely, if ever, too large. It is very seldom that it is protected against fire or any attempt made to make it fireproof. The losses sustained in power plants through fire are hard to estimate, because of heat, moisture and dirt, which greatly impair the apparatus, and, although the injury may not be apparent at the time, it is sure to develop later on when the plant is again in operation. This will apply more particularly to plants equipped with electrical machinery.

Another point is that of ventilation. The cooler and cleaner the condition of both engine and dynamo, the more efficient and serviceable is their operation; therefore large windows are desirable and generally cost less per square foot than the average wall. In constructing a brick building, it is a good plan to build 20-inch brick studs, 12 feet apart, putting two window frames 5 feet in width, or 3, 40-inch frames in each panel, except where doors are located. This construction reduces the cost of the building and favors enlargement. A building thus constructed having a truss work in sections to correspond, is easily extended at the two ends, and, as an increase in business should be expected, although this part of the problem is frequently overlooked, plans should be made for enlarging the plant to meet the increased demands. It is important that sufficient ground area be secured upon which to erect the building. If the plans have been arranged right, after the first plant has been outgrown, the additional land will allow of an extension of the building without tearing down and altering the old part.

In single floor stations the boiler, engine and dynamo as well as all the shafting should be placed on a separate foundation in the ground, and no part of the building should be used to support any piece of machinery. It should be remembered that the building is only a cover for the protection of the machinery, every part of which should be erected as if the building and walls did not exist.

The boiler room floors should be of cement or concrete and it is well to construct a sewer drain running from each pump, heater and boiler. In building the dynamo foundation, care should be taken to see that it comes above the floor line, and that the floor is so laid that it will not only readily drain and dry after scrubbing, but permit of washing down with a limited supply of water. When the engine room is on the ground floor it is a good plan to place all piping to it below the floor line providing there is ample room for easy and immediate access to all piping, valves and connections.

One of the handy and necessary devices around the plant is the lifting jack. A traveling crane running over each piece of heavy machinery is very desirable in case of accidents and repairs, while in smaller stations a fixed support for a chain and tackle will answer.

In designing a power plant it is essential that the boiler room should be shut off absolutely from the engine and dynamo room by a fire wall of the necessary thickness. The connecting doors should be of iron.

When a plant has been completed and put in operation a comparative test of efficiency, of the boilers, engines, dynamos and circuits, should be made annually. This will invariably effect a saving of many times the cost of the test in discovering and locating any unknown wastes which may exist.

When purchasing power plant machinery, there is an advantage in buying the engines, boilers, heaters, pumps, piping, etc., from one company when it is possible and advisable, as one is more apt to get a harmonious outfit. If any piece of machinery fails to do its work, one knows where to place the blame, and the installation will proceed more rapidly as the machinery will be shipped in the order in which it is needed.

There are many plans that can be utilized in the design of a power house. Following are illustrated a few plans which will perhaps aid some engineer in arranging his machinery. In Fig. 1 the plant is square the engine and two boilers both headed in the same direction. In the boiler room, are shown two boilers in battery, with a smoke connection to a round steel stack resting upon a brick base on the outside. The feedwater heater, boiler feed pump, also the connections from the pump to the boiler and the steam line from the boilers to the engine room are shown, as are the headers and connections over the boilers. As will be seen, there are two doors at the rear of the boilers, one between the boiler and engine rooms and one to the outside. There is one midway of

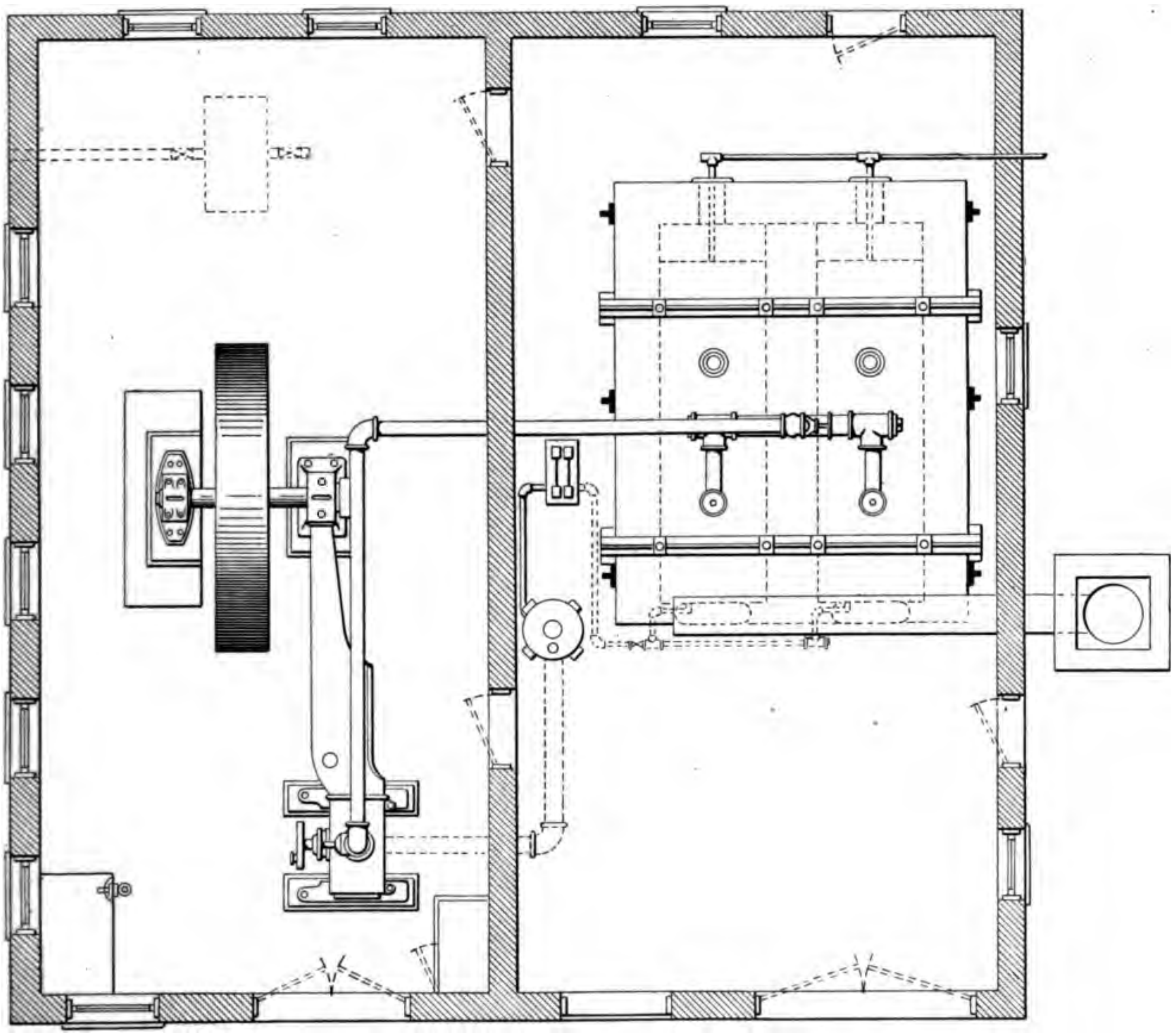


FIG. 1. PLAN OF FACTORY PLANT CONTAINING TWO BOILERS, AN ENGINE AND THE ORDINARY AUXILIARIES.

the engine entering into the engine room, and a plentiful supply of windows which insures a well-lighted engine room.

Another feature of this plan to be commended is the fact that the boiler setting is independent of the fire room walls. This allows for examination of the brick work on all sides of the boilers and the settings of the boilers are not affected by the severe weather of the winter months, as would be the case if the outside boiler settings and the fire room walls were one. No provision has been made, however, for a duplicate plant, either in the boiler or engine room, and in case more boiler capacity were needed the old boilers would have to be removed and larger ones substituted, thus causing a shutdown, or the building would have to be enlarged in order to set in two more boilers, the rear ends of which would be next to the engine room partition. If, in the first place, the boilers had been set at right angles to their present position and the building made a few feet longer, there would have been sufficient room to put in a duplicate boiler plant without disturbing the old battery of boilers.

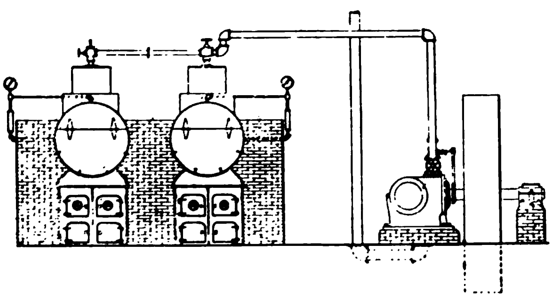


FIG. 2. RIGHT HAND SETTING OF ENGINE AND BOILERS.

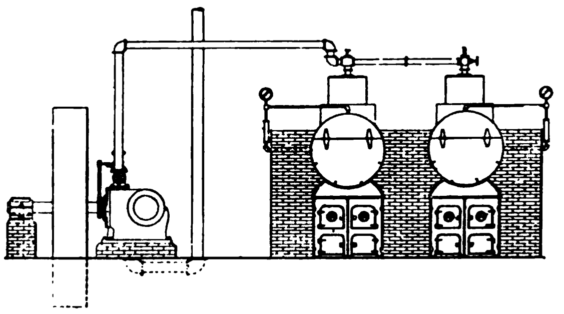


FIG. 3. LEFT HAND SETTING OF ENGINE AND BOILERS.

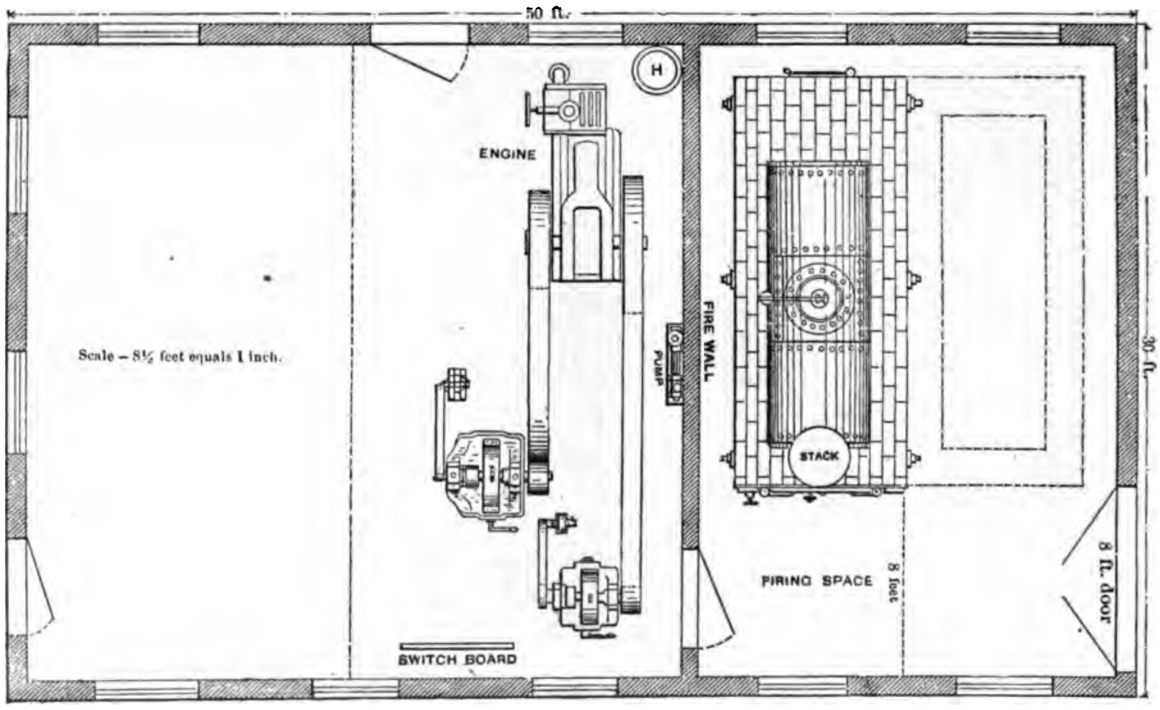


FIG. 4. A PLAN WHICH ALLOWS FOR DUPLICATE INSTALLATION.

The same fault exists in the engine room; if additional power is required the old engine must be replaced by a larger one or the end of the building torn out and the engine room enlarged. Another improvement that could have been made would have been to place the engine in a position just opposite to the one which it occupies. This would have reduced the steam pipe line and also given a greater distance between centers of the engine flywheel and the driven wheel on the shaft, but a right hand engine would have been necessary. Another improvement would have been to have placed the pump in the engine room, where it would have been kept clean and free from the dust of the fire room. Figs. 2 and 3 show a right and left hand setting of engine and boilers.

In Fig. 4 is shown a plant arranged for a duplicate installation. As will be seen it consists of one boiler and one high-speed engine connected to two electric hines. In this instance space has been allowed for her boiler in the boiler room, and a duplicate set ıe engine room. The length of the station is 50 and the width 30 feet, but if only one boiler and ne are to be installed, the length of the building be reduced to 28 feet. By looking at the plan it be seen that the pump and heater are placed in engine room out of the way of the dust and dirt ch is always present in the boiler room. This plan rides for sufficient lighting by means of windows doors and allows room to work around the engine ase of breakdowns and repairs. The boiler has cient space between the setting and the fire wall ermit examination and repairs. The same provision has been made in case a new boiler is later on installed.

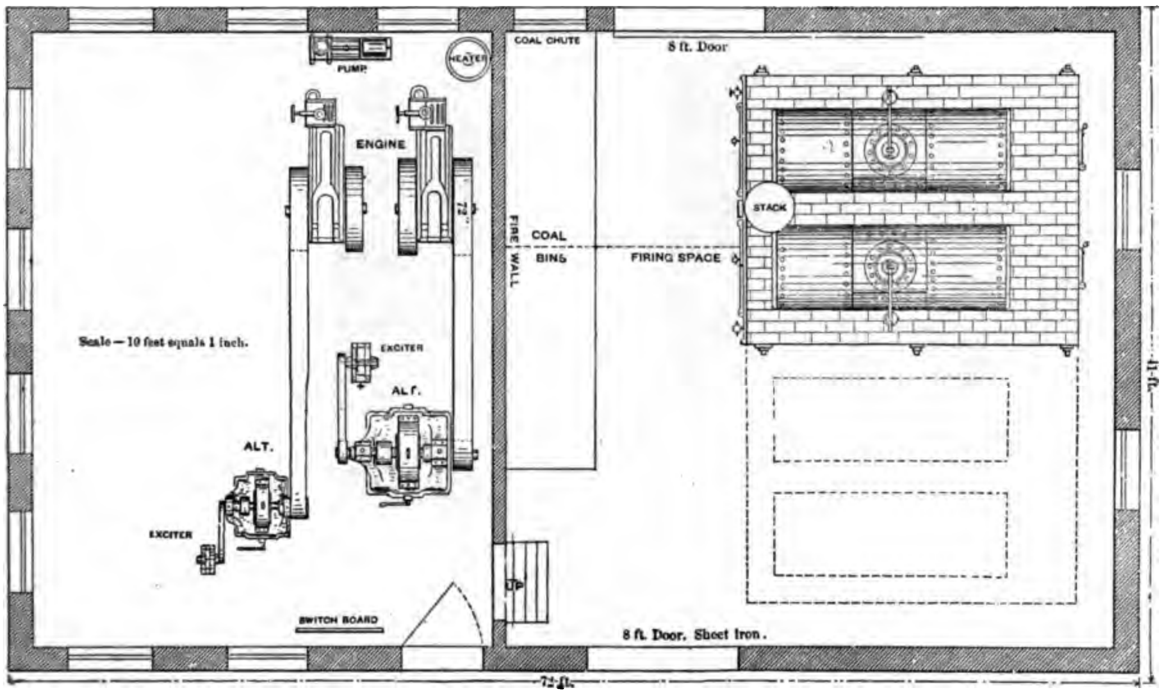


FIG. 5. THIS PLAN ALLOWS FOR DUPLICATE BOILERS, ENGINES AND GENERATORS.

There is one objection to this plan. If another boiler is placed in the fire room it will be necessary to provide another stack. If in the first place a stack large enough for two boilers had been erected on the outside of the building at the end, and the boiler uptake connected to the chimney by means of a flue running the length of the boiler room, in installing a new boiler, it would only be necessary to connect it to the old smoke flue. The doors at the end of the fire room would have been improved if they had swung out. As they are, if another boiler is added one side of the door will swing against the boiler front. Furthermore,

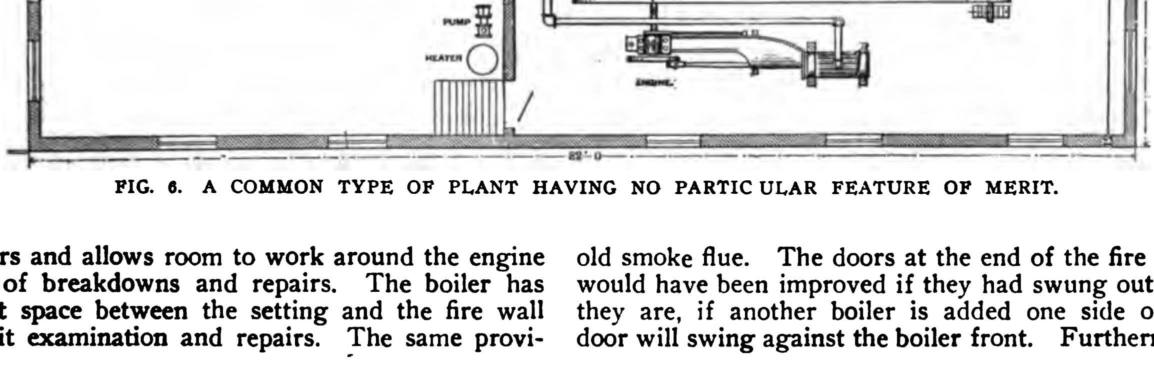


FIG. 6. A COMMON TYPE OF PLANT HAVING NO PARTIC ULAR FEATURE OF MERIT.

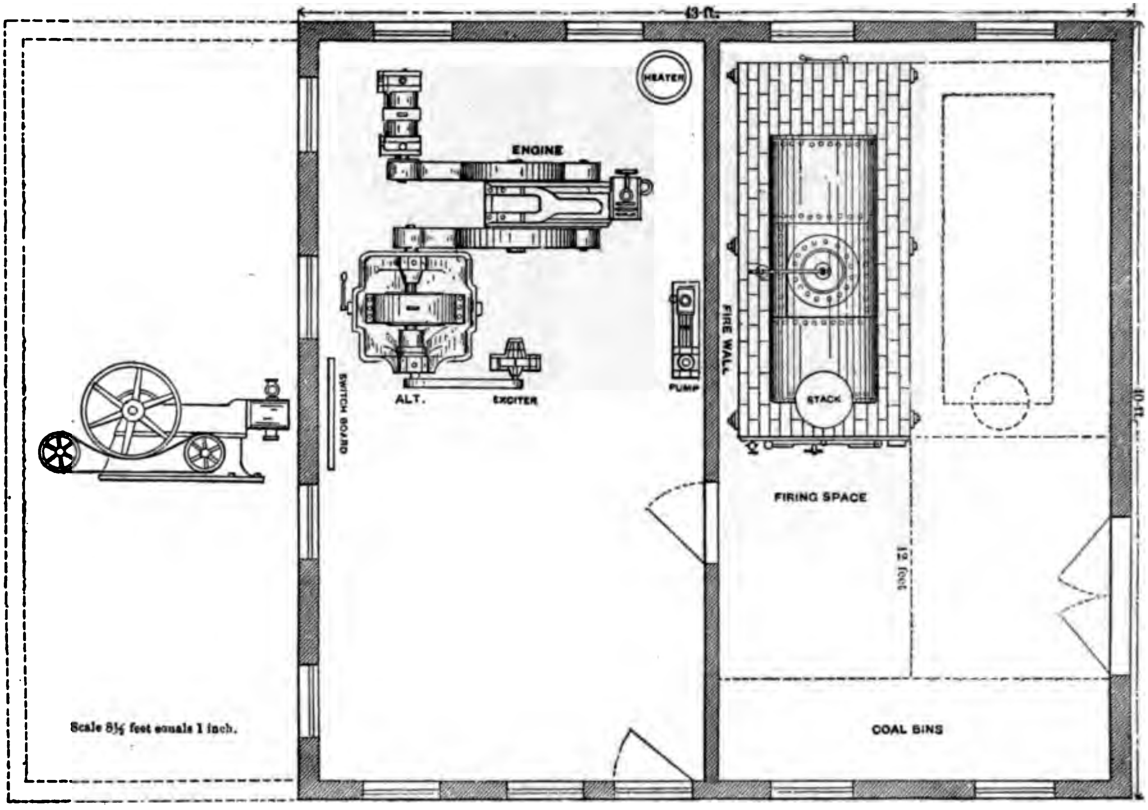


FIG. 7. THE EVANS SYSTEM OF DRIVING, WHICH HAS BEEN DISPLACED BY THE DIRECT CONNECTED UNIT.

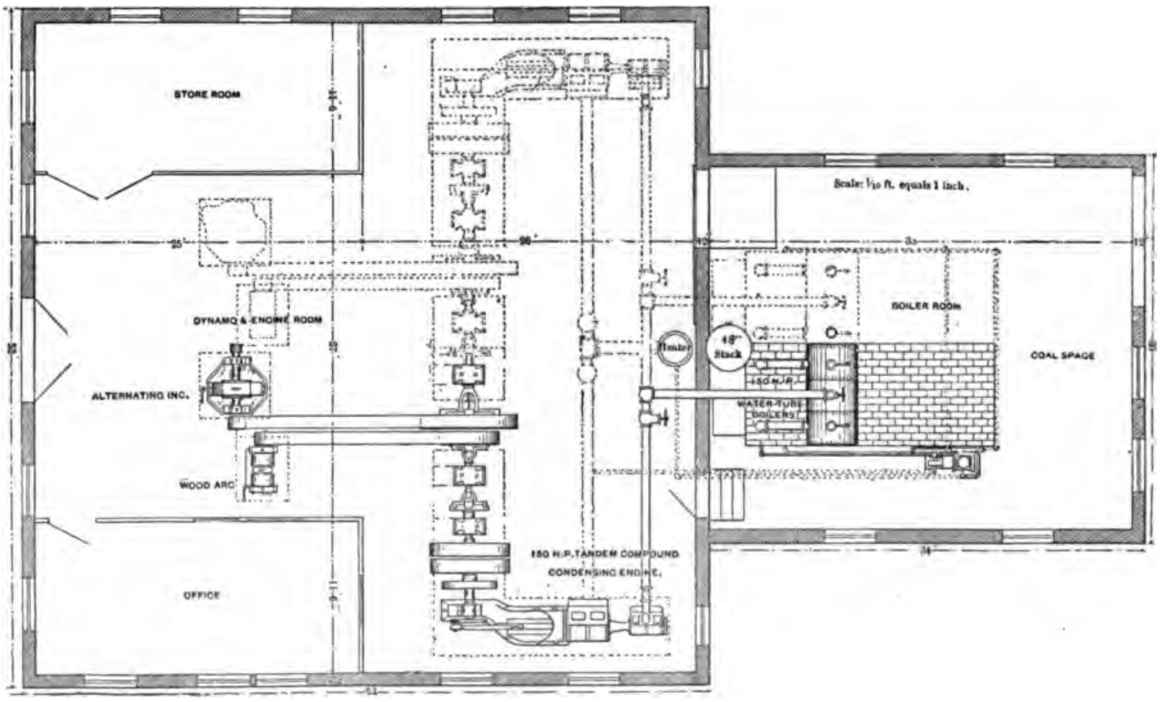
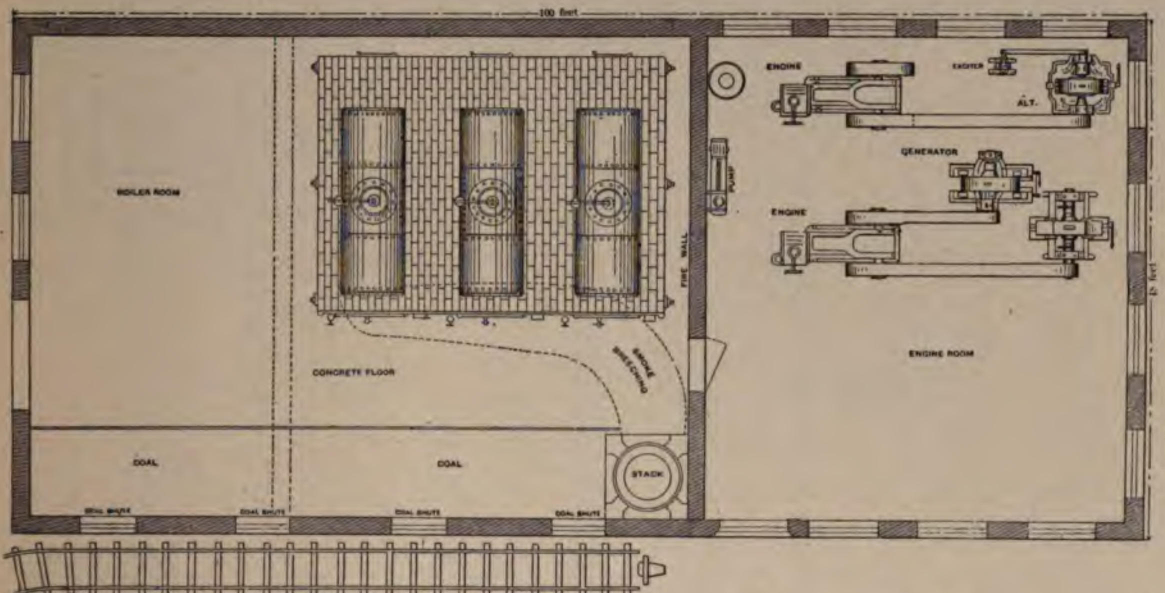


FIG. 8. PLAN OF PLANT CAPABLE OF DOUBLING ITS CAPACITY, THE DOTTED LINES SHOWING THE DUPLICATION.

he coal supply is naturally kept in front of the two ers, the doors cannot open wide because of the coal . It is always a good plan to have the fire room rs open outward, as they can be opened regardless what may be piled on the floor on the inside.

'ig. 5 shows a plant designed more as that in Fig, hould have been. It will be seen that a dupli- plant has been provided for, with ample space for machinery with the exception of the feed pump ich comes directly in front of the engine cylinder d. The pump could also have been nearer the ter with advantage. A commodious area has been in front of the boilers for firing space, and there mple room for the coal bins.

'here is one objection to this plan. The boilers are ited below the engine room, which makes it neces- for those in charge to do considerable running up down stairs. There is this advantage, however, the coal bins can be filled by means of the coal ite from the street level above, and also that there ery little likelihood of water coming over into the ine cylinders, as the engines are so high above the er level. It will be noticed that the doors in the room are of the sliding type, which eliminates the ection of the swinging doors mentioned in Fig. 4.



. 9. THIS PLAN ALLOWS FOR ADDITIONAL BOILERS WITHOUT EX SIVE ALTERATION OF THE SMOKE BREECHING. ALSO CONVENIENCE OF COAL ELIVERY.

n entirely different type of power plant is shown in . 6. In this plant no thought has been given to a licate set, and the only thing that can be done in of increase in business will be to put in one extra er and increase the size of the engines when they me overloaded. In this plant it was figured that economy of the Corliss engine, with shafting, was iter than that of the high-speed engine belted direct. this instance the generator was put on the high- d engine, as shown, and used for day service.

here is a question right here as to whether it would have been advisable to extend the shafting and run generator from the Corliss engine, although this ld, of course, depend upon the load which the generator was carrying. The pump and heater are placed in the fire room, but it would have been better to have had them located in the engine room away from the dust and dirt and under the engineer's supervision. In this case they would not have required moving if another boiler was put in place. There would, however, have been this disadvantage: the fireman would have been obliged to go into the engine room every time the speed of the pump was changed.

This plant would doubtless have been more satisfactory if the stack had been built next to the outside boiler and the flue caps connected to it, rather than having one stack for both boilers placed centrally between them. As will be seen, if another boiler is put in place, it will be necessary to either get a new stack for the new boiler or increase the size of the old one. Another improvement in this plant would have been a larger space for coal storage in front of the boilers and this is a feature which is often neglected and which is a very important one. In this plant the engine ro floor is considerably higher than that of the fire roc which, while it prevents the liability of water bein arried over into the engine, makes it rather inconvenient for the engine room force.

It sometimes happens that the space which is available for a lighting or power plant is so restricted that it is impossible to construct the plant along ordinary lines. In Fig. 7 is shown a plant using what is known as the Evans system of driving dynamos. There is space provided for a duplicate boiler and engine set which would not have been available had the engine been turned so as to stand lengthwise of the engine room and the ordinary method of belting used. In this instance, however, by belting, as shown by the engine outline at the left, the desired object is accomplished without loss of very much space. This method of belting does not give the belt contact that is obtainable in the ordinary way, but by looking at the dotted lines one can see the floor space which is saved by using this method of belt transmission. Direct connected units have taken the place of this system to a great extent.

Fig. 8 shows a station which is designed with the provision for readily doubling the capacity without rearrangement or rebuilding of any apparatus or machinery. It will be seen that the boilers are the water tube type which are adapted to a low grade of fuel. Liberal space is provided in the dynamo room beyond the necessary requirements, which is a good thing when it can be afforded. The dotted line shows the plans for the additional plant when it is required.

In Fig. 9 is shown another style of plant which is suitable for electric lighting. This plan is designed with the idea of further increase in business. Coal is delivered to the boiler room direct from the cars through the coal chutes. The engine room is amply lighted and ventilated by the numerous windows. Here, as in other plants where room for an increase in the boiler capacity has been provided, the smoke breeching should be made large enough in the first place to take care of all the additional boilers which may possibly be required.

In Fig. 10 is shown the plan view of a factory power plant with the engine direct coupled to a generator which furnishes current for motors distributed at convenient places throughout the factory. This is probably one of the most economical as well as convenient forms of power plant, eliminating as it does all belting and losses of belt slipping, together with the space which must of necessity be taken up when belt drive is used. The piping connections over the boilers show that provision has been made for expansion and contraction. Space is provided for another boiler as well as a duplicate set in the engine room. When an engine is guaranteed to regulate within 2 per cent for all the changes of load and steam pressure and to deliver an indicated horsepower for every 20 pounds of water, running noncondensing with 125 pounds steam pressure to the square inch, it shows almost as good results as are obtained anywhere at the present time. The above was guaranteed of the plant shown in Figs. 10 and 11, the latter being a side view. The boilers are of the Heine water tube type and were put in place with a guarantee of 70 per cent combined boiler and furnace efficiency, which is equivalent to an evaporation of about 8 pounds of water per pound of coal. As will be seen, the boiler room is located at a much lower level than the engine room, which permits of the gravity return from the heating system of the building.

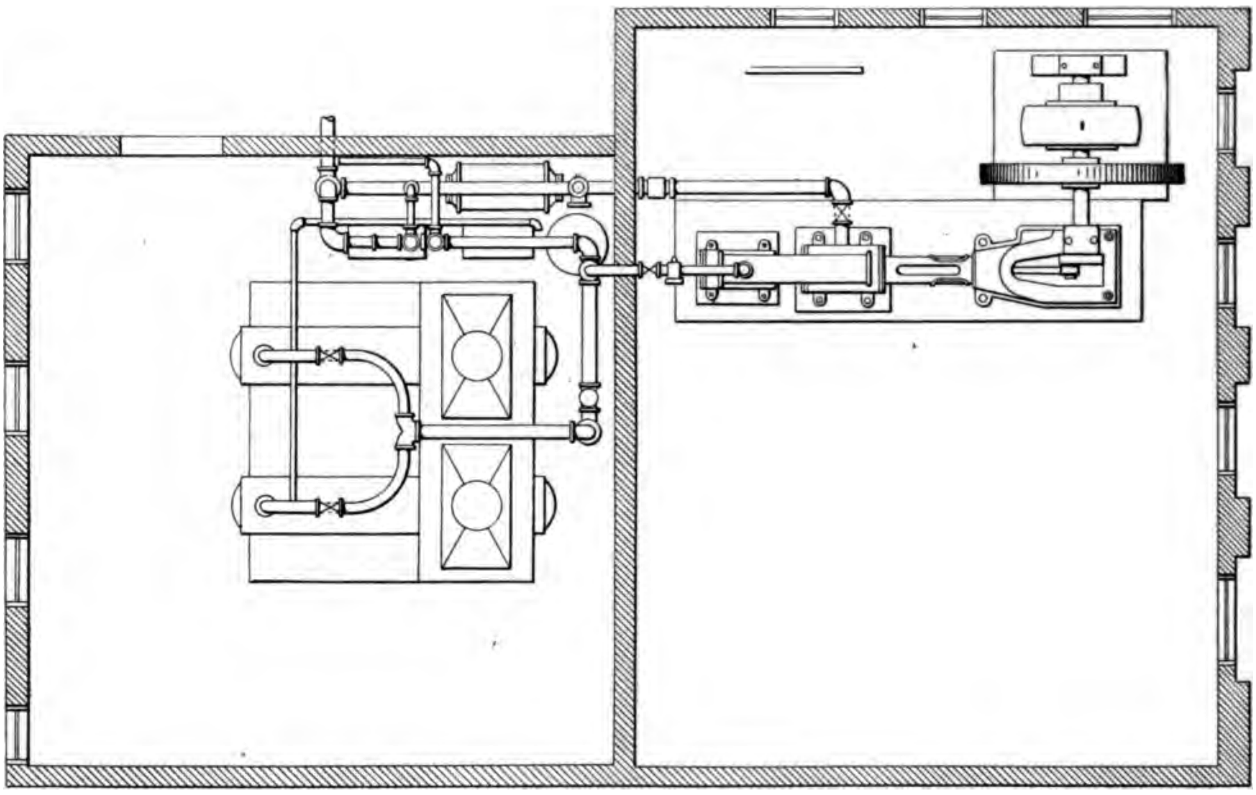


FIG. 10. PLAN VIEW OF MODERN FACTORY PLANT CONTAINING DIRECT CONNECTED UNIT.

Another plant is shown in Figs. 12 and 13, Fig. 12 being a sectional view of the typical power plant which is used in the cotton mills of the East and South, ranging in size from 700 to 1,500 and 2,000 horsepower. It has been shown that the location of the boiler and engine rooms in relation to each other may greatly increase or decrease the first cost as well as the efficiency of the plant. It is the custom in this type of plant to place the boilers and engines in parallel rows, when they are located in one building as shown, with a wall between, with the cylinders of the engines next to the rear of the boilers. This is a very good arrangement, especially when there is a likelihood of an enlargement of the plant in the future. By this means a neat and substantial steam connection can be made between the boilers and engine at a low

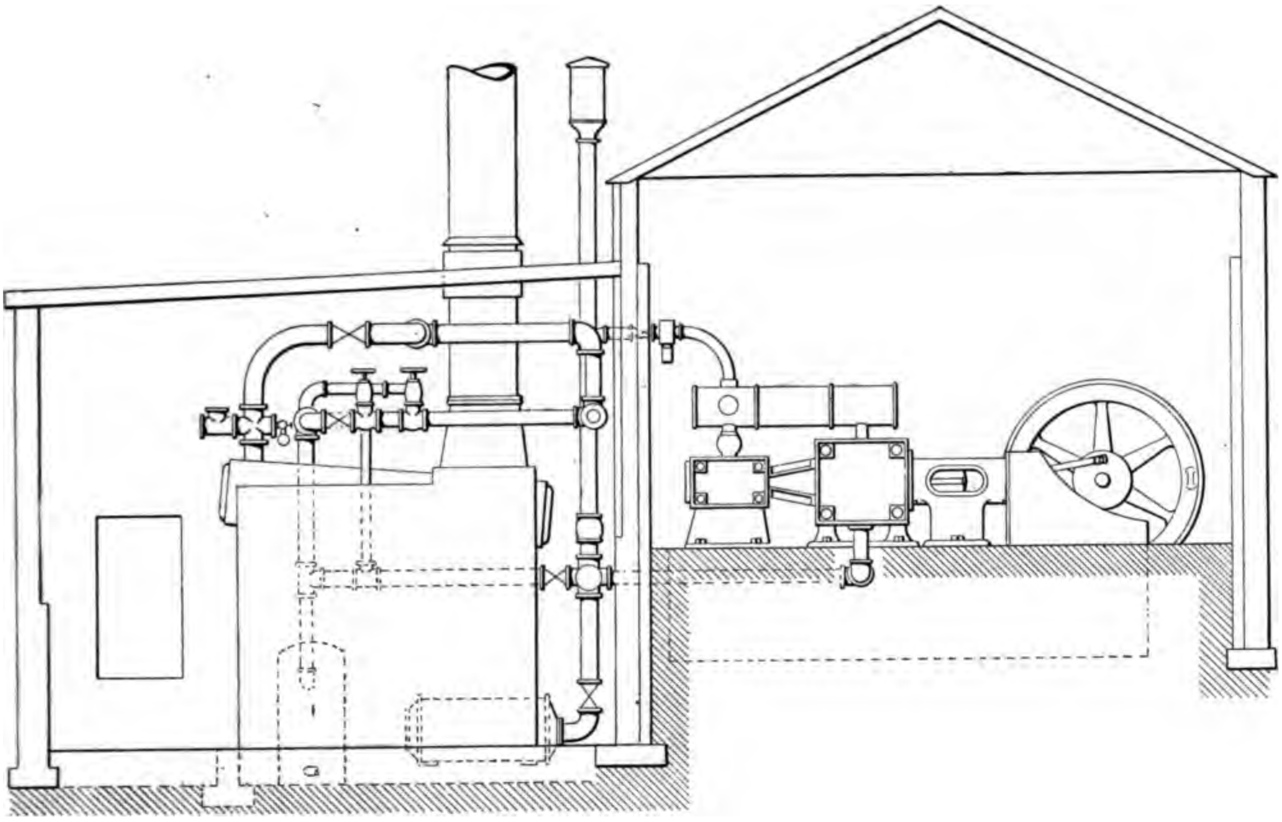


FIG. 11. ELEVATION OF FACTORY POWER PLANT SHOWING PIPING.

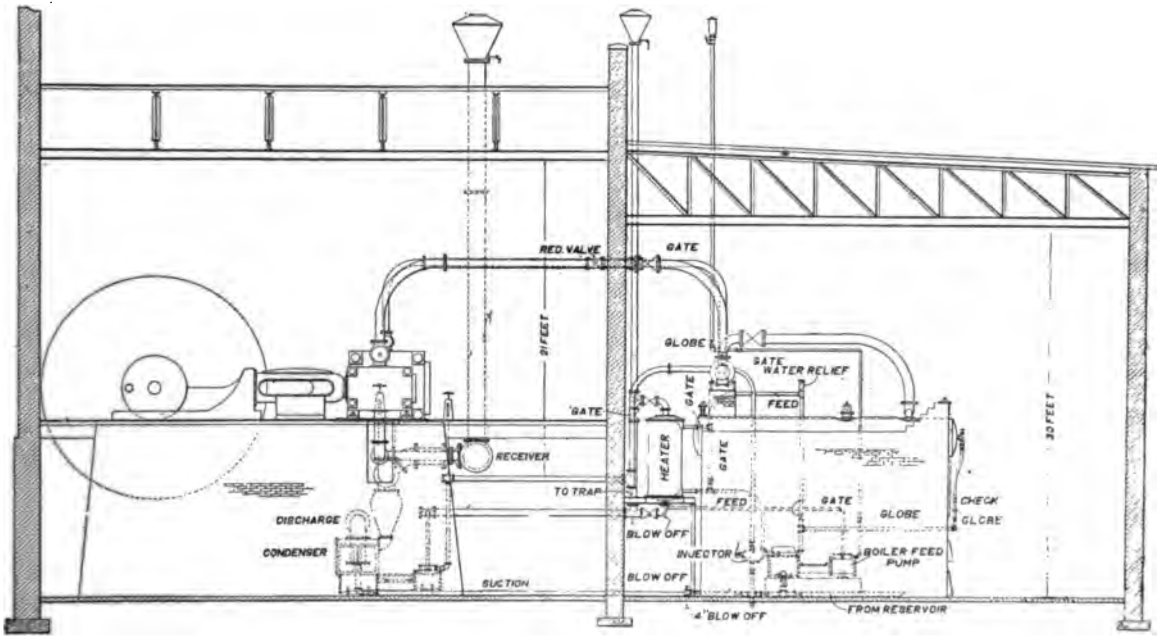


FIG. 12. POWER PLANT COMMONLY INSTALLED IN COTTON MILLS.

cost and at the same time all due allowance can be made for expansion and drainage of the steam main. As a general rule, long-turn bends are used between the boilers and steam drums and between the steam drum and the engine.

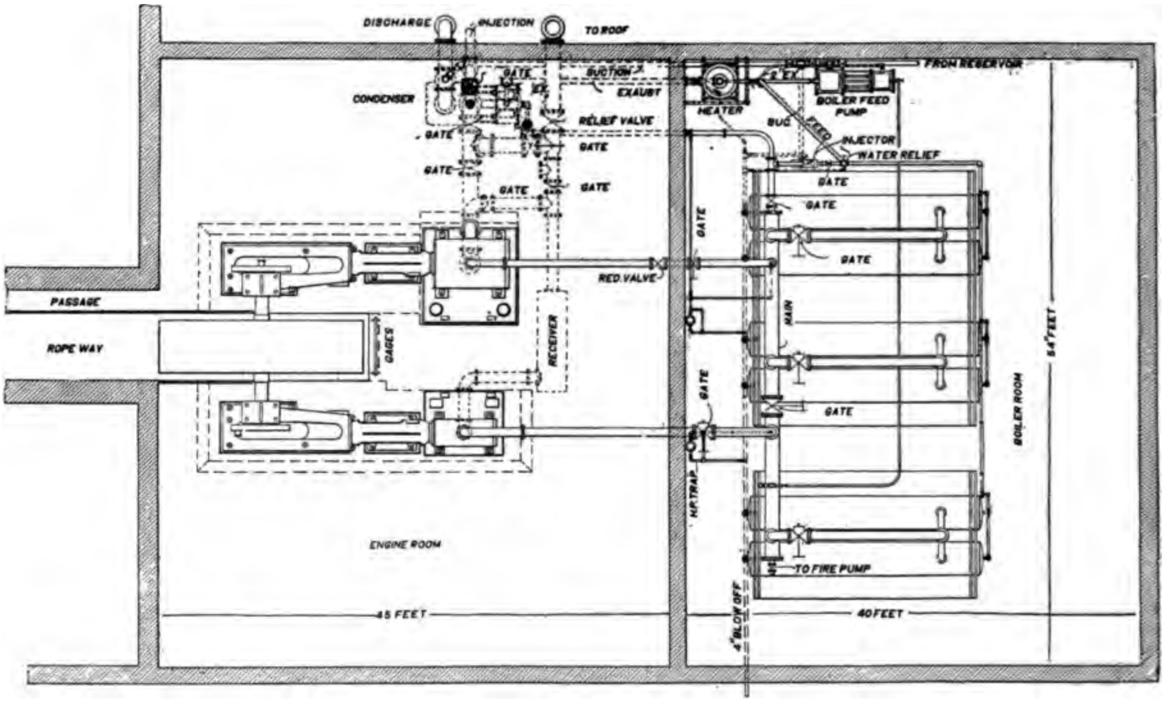


FIG. 13. PLAN VIEW OF FIG. 12.

It will be noticed that both the high and low pressure cylinders are connected to the steam drum, which allows the low pressure cylinder to use live steam at a high pressure in case of accident to the high pressure cylinder. By this means the engine can be operated giving out half its usual horsepower. The method of supporting the drum over the boilers is shown in Fig. 12, also the connections of the boiler and engine, which allow for expansion. The arrangement of exhaust piping between the high and low pressure cylinders shown is common, but the arrangement of piping the exhaust from the low pressure cylinder to the atmosphere and condenser is a later method which is coming into favor. Fig. 13 shows that both cylinders can be run at high pressure if required, and that the exhaust from both cylinders can be passed either through the condenser or direct to the atmosphere. The high pressure cylinder can be run non-condensing and the exhaust used for heating purposes, while the low pressure cylinder can be run at the same time with live steam, but condensing. The piping of the auxiliaries, their location and the different connections are also shown.

It seems fitting to bring this article on power plant plans to a close by producing a plan or cross section of the largest generating plant probably in the world, that of the Interborough Rapid Transit Co. of New York. This plant, Fig. 14, has been described in the REVIEW and in all other engineering journals, therefore but little space will be devoted to it here. The steam generating system will consist of 72 boilers and accessories, and 24 Green economizers will be needed when the full equipment is in place. There will be 9 boiler feed pumps, and 10 closed feedwater heaters. In this installation 36 boilers are fitted for hand firing and 16 with stokers. The piping system is the result of much study and it has been the aim of the designers to arrange all valve fittings, etc., about the center line of each section so that a person familiar with any one section will be able to go to any other section and find any given valve in the same relative position to the others.

The power plant is divided into 6 sections, the first 5 sections being alike, with the exception of the fourth, which is the turbine section. The large reciprocating engines are of 8,000 horsepower capacity each, while the four turbine units will each generate 1,250 kilowatts. The capacity of the whole plant will be, when complete, 130,000 horsepower, which will undoubtedly make it the largest power plant in the world.

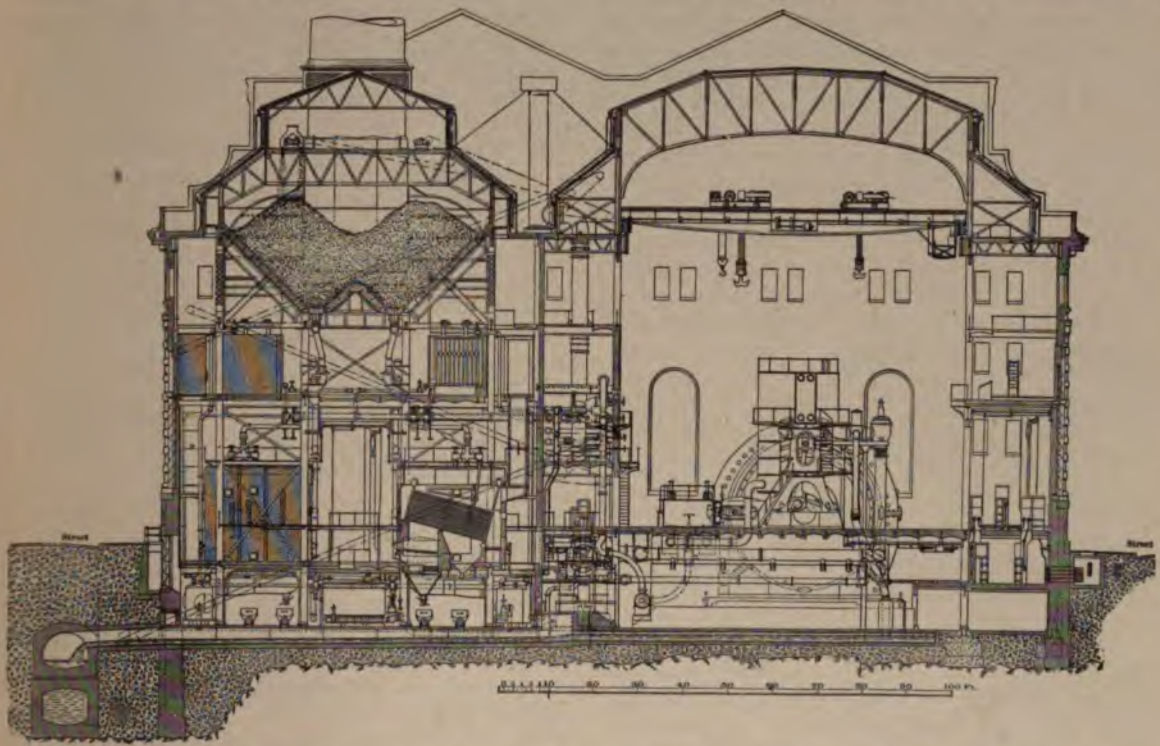
To find the quantity of water elevated in one minute running at 100 feet of piston speed per minute. Square the diameter of the water cylinder in inches and multiply by 4. Example: Capacity of a 5-inch cylinder is desired. The square of the diameter (5 inches) is 25, which, multiplied by 4, gives 100, the number of gallons per minute (approximately).

The *Engineering and Mining Journal* is authority for the statement that there is as much energy in one ton of coal as 40,000 laborers exert in a day of 10 hours. At present, however, according to the same authority, only 1-10 of this force is utilized in the steam engines which consume the coal. Yet the cost of doing certain work of the crudest kind is about 1,000 times as much, if human muscle is used, as it is if the work is done by a steam engine.

ENGINES.

\n engine is, it is needless to say, of the utmost im- tance. Unlike the boiler, the selection of an engine ıot dependent upon local conditions, the service for ich it is required being the main consideration. The rket offers such a large variety of engines of differ- types, all of which have their distinctive features re or less valuable, that it is difficult to pick any particular engine as being better adapted to a cer- ı plant than another without entering into the par- ılars of the construction which we cannot do here. do not refer to the type of engine, for it is well own that the high, medium and low speed engine h is better adapted to certain kinds of work.

The selection of an engine is not the only important tor relating to it. Its location in the plant in re- d to the boiler, light and room to get around it for ention and repairs are all important. In large plants ere many engines are employed this is especially ired and the most modern plants are designed with these points well to the front.



IG. 14. CROSS SECTION OF THE LARGEST POWER PLANT IN THE WORLD, THAT OF THE RAPID TRANSIT CO. OF NEW YORK.

It is evident as one surveys the electric power sta- n field that in America the low speed type of en- e is almost exclusively used, although there are tions operating with high speed engines. The con- sion is that both the high and low speed engines are table for this purpose, although the low speed en- e is given the preference.

t is not the purpose of this paper to discuss the rits of any engine, but it is a fact that if one goes side of electrical engineering and compares the ults, from the engine point of view only, he will l that the low speed engine still holds the record for steam consumption. The conditions, however, un- which engines in most electric power plants operate are such that very little can be learned from their records which will help in the solution of the problem. The load factor is uncertain in most cases, and the condition of the other machinery also. The large amount of steam piping which is necessarily kept alive, but is not used to its full capacity, is with other poor conditions, the reason for the very unsatisfactory results which many power plants show in pounds of coal per horsepower generated.

The high speed engine with a short stroke gives a higher mean effective pressure in the cylinder and that in combination with the quick stroke, reduces the condensation in the cylinder to a minimum. In so far as this takes place the high speed engine has the advantage over the low speed engine. It is not practical to make a high speed horizontal engine of large size, and if the horizontal engine is fitted with Corliss valves, it is much better drained than the vertical engine, either high or low speed. The wear of the piston is greater in the horizontal engine than in the vertical type, but this is reduced a great extent by having tail rods, and the actual amount of wear which does take place, is largely due to the material of which the cylinder and piston are composed. In a well designed engine of good proportions this wear is not excessive. It is not uncommon to find engines which have been run for more than 15 years without having the cylinder rebored.

In choosing between high and low speed engines, the fact that the high speed engine requires more watching and more oil, as well as repairs, than the slow speed engine should be remembered.

Undoubtedly the reciprocating engine of the future will be of slow speed type, operating condensing of either the vertical or horizontal type.

The horizontal slow speed engine is undoubtedly suited for long runs, and does away with the necessity for having steam pipes in the engine room above the floor, which enables the steam piping to be reduced to a minimum. By adopting this method, the difficulties of steam piping can be overcome, and the engine kept neat and clean. Free use of the traveling crane from one end of the engine room to the other is also permitted.

Another point is that the engine can be kept clean at a minimum expense and trouble and the repairs will be found to be reduced to the lowest possible figure, and more so if the valve gear be of the Corliss type. Another point in favor of the horizontal slow speed engine is that it is easily accessible for repairs. This also applies to the generator, which in large units is direct connected. Here is where the horizontal engine has the advantage of the vertical engine, because when any repairs are necessary to the generator of a vertical engine, in order to remove the upper half of the field magnet ring or to get at any important part of the generator, the engine must be dismantled to a certain extent. In some instances this means that it must be practically rebuilt. If the engine is inconvenient to get at the cost of the repairs will be high and the time expended lengthy.

The question of condensation is of great importance, and considerable stress is laid upon cylinder condensation by some engineers while the condensation in the steam pipes which is more easily avoided than that in the cylinder of the engine and amounts to many times more, is often given but little consideration.

In large plants the question of whether the cylinders shall be compound or triple expansion must be determined by the conditions under which the engine will operate. In some plants it would be advisable to have both, but the triple expansion engine has no particular advantage unless it can be fully loaded at all times.

In the smaller plants the two principal factors to be considered in choosing an engine are the first cost and economy of operation. Where a small amount of power is required or the power is to be intermittent, an inexpensive engine will often do as well as an expensive engine. Where the cost of power is high, and a large item in the operating expenses, and where the plant is to operate continually, it is folly to get any but the best engine. It should be remembered that the simple slide valve engine is as useful in some plants and answers the purpose better than would a high class compound condensing engine. This is true in spite of the fact that the former frequently uses 40 or 50 pounds of steam per horsepower hour to 18 pounds required by the latter.

When the load is reasonably uniform the compound engine will give better satisfaction than the simple engine: but with a fluctuating load the simple engine is to be preferred, because it governs better and is usually as economical. The first cost is also less and the expense of maintenance not so much, as two cylinders naturally require more attention than one.

A condensing engine will pay well if the water is not too expensive, but with the aid of cooling towers the cost of condensation can be reduced where city water is used. It is much more expensive, however, because it requires condensers and steam jacketing, which also raise the cost of maintenance.

The cost of steam plants varies, of course, with different locations, but the cost can be computed to
tain extent by using approximate figures. Fo
stance, the different kinds of boilers can be bas
a certain cost per horsepower. Horizontal
boilers can be figured as costing from $9 to $1
horsepower; vertical boilers at from $10 to $1
horsepower and water tube boilers from $15 to $1
horsepower. The practice of purchasing boilers
much per horsepower is misleading. A better
to pay so much per square foot of heating su
which averages about $1 per square foot.

In the purchase price of a steam engine, th
per horsepower within certain limits diminishes
engine increases in size. It has been estimate
the cost of the complete steam plant is from $45
per horsepower for high speed plants, and fro
to $75 per horsepower for Corliss plants. This
not include, however, the cost of railway f
charges. The following condensed estimate o
cost of a plant with a 100 horsepower simple no
densing engine was made by a well-known
building company:

100 horsepower simple noncondensing engine, on cars ....$
Freight to destination, estimated at............
Cartage and placing in position, about $5.15 per ton ....
Foundation and masonry.....................
Boiler, 100 horsepower.......................
Freight on boiler............................
Handling boiler ....
Boiler foundation ....
Erection of boiler brick work, 15,000 red brick at $12 per thousand, laid.....................
1,500 fire brick at $40 per thousand, laid.......
Steam pump ....
Brass tube feed water heater.................
Pipe connections, steam, exhaust and water pipe

These estimates are based on the supposition th
distance between the engine and boiler is not
than 20 feet, that the water supply is brought in
engine room, and that the exhaust is not carried
than 20 feet from the outside of the engine
Other items are as follows:

Pipe covering for all steam pipes..............
Stack for boiler (iron).......................
Erecting stack (this cost varies).............
Labor in handling heavy pieces...............

Other items may be added, such as railwa
penses and board for the erectors and it is s
add for contingent expenses from 5 to 10 per

For a compound condensing plant a 100 horse
compound engine would cost $1,600 with an addi
cost of $300 for a jet condenser. In installing a
pound engine it should be borne in mind that th
of the boiler would be reduced and also the firs
price about 10 per cent. This would also make
duction in the cost of freight, hauling and ma
There would also be a slight cost in the matter of
pumps, heaters and pipes, which is too sm
make any great difference in the net amount. I
be fairly estimated that the cost of feed pumps,
is a comparatively small item, is from 50 cents
per horsepower. The ordinary closed heater
1⅓ square foot of heating surface per rated horse
costs from 75 cents to $1 per horsepower.

:e of the ordinary jet condenser with connecting es may be taken as from $750 to $2,000 for engines ying from 300 to 2,000 horse power. Thus the :nula for condensers would be, cost = 500 + 1.0 sepower dollars, or $500 plus $1 for each horse- /er of the engine. The expense of piping, of rse, depends upon local conditions and no general mate can be given. In deciding upon which will the most economical plant for any service it is essary to consider the relative daily expenses, the ıcipal items of which will be fuel, oil, waste and :er, together with the usual attendance, repairs, de- ciation, insurance, taxes and interest. The cost of l will of necessity vary from $1.25 per ton to $4.10 . sometimes more, and although the average is often en as low as $2 per ton it is doubtful if this is a estimate for the general run of steam plants.

Vith the ordinary simple noncondensing steam plant ıfe estimate is 30 pounds of dry steam and 5 pounds :oal per horsepower with slack coal, although there many noncondensing engines which would show consumption of steam as well as coal. With com- nding engines, the coal consumption can be re- ed to about 3 pounds while the steam consumption ıld be reduced to 20 pounds per horsepower hour a boiler ⅔ the nominal horsepower will generally sufficient if steam is not used for other purposes. : cost of attendance will depend upon the size of plant, the larger the plant the less will be the cost. :h coal fired by hand 200 horsepower is the maxi- n amount that one fireman can attend to with any ree of efficiency, but with the mechanical stoker ; possible to reduce the labor expense ¼ in large ıts. This however varies with different plants. : cost of engine attendance is greater for higher ;ds and is increased by the introduction of com- nding or condensing engine.

'he item of oil and waste is very small in well ıaged plants, but is an item which should not be sight of. The cost of water is also a slight ex- se unless city water is used. The customary rate manufacturing establishments in cities is 40 cents 1,000 cubic feet, which amounts to ½ cent per er horsepower per hour for a noncondensing en- :.

'he common practice has been to allow 10 per cent depreciation, interest on investment and main- ınce This is too little and if 12 per cent were al- ed it would be a safer margin to figure on. In :e instances the life of an engine is based at from o 25 years, but in the rapid development of electri- transmission the life of an engine has been reduced it is discarded at from 10 to 15 years after being into operation. The usage it receives has a good l to do with its life, but the prevailing custom of ıy is to get all out of an engine there is in it in the t possible time, because an idle engine is a losing ›osition.

'o find the capacity of a cylinder in gallons. Multi- ng the area in inches by the length of stroke in ıes will give the total number of cubic inches; divide amount by 231 (which is the cubical contents of a 5. gallon in inches), and the product is the capacity ;allons.

ISOLATED ELECTRIC PLANTS.

The economy of isolated electric lighting plants is based entirely upon local conditions. One collection of reports from cities, towns and private parties owning their electric lighting plants may indicate that isolated plants are to be recommended, while another collection of reports will as surely indicate that such a project is undesirable. This variation of reports is due to the fact that a large number of isolated plants are operated in a slipshod manner, which, together with the difference in local conditions will in some instances make the cost of operation in one particular plant greater than another. This is one of the reasons why it is a matter of conjecture as to whether electricity can be generated under such conditions, cheaper than it can be obtained from a central station. It must be remembered that the isolated plant does not necessarily mean one situated in the outskirts of some large town or small city. It includes the plants which are situated in hotels, office buildings and apartment houses which furnish their own power for lighting, elevators, etc., instead of buying it from a central station.

Very few of the small isolated plants keep a record or have reliable figures showing the various conditions of operation. In fact it may be said that a correct knowledge of the electrical output of many of these plants is not known, as no readings are obtained from the watt meters or ammeters.

Every engineer who has had experience in electric lighting knows that the only proper way to figure the output of a plant in kilowatt hours at the switch board, is from the readings of the watt meter and ammeter, which should be taken at least once an hour, while every 15 minutes or half hour would be preferable.

From the first electric lighting grew in popular favor on account of its manifold advantages, and as the cost of production diminishes its use is extending at an ever increasing rate and without doubt when the price has been sufficiently reduced it will be universally used as an illuminant. Important as electric lighting is, the use of electrical motive power will, to all appearances, eclipse it in importance. Already small users of power are adopting it wherever available, while large factories, requiring hundreds of horsepower to operate, are driven by its means.

In order to design and operate an electric lighting or power station successfully, a most liberal education and a knowledge of almost every kind of engineering is required. There must be a solid groundwork of mathematics, general physics and chemistry, as well as a thorough training in steam and mechanical engineering and in electrical science. To all this knowledge, which can be acquired by persistent study, must be added tact and ability to manage men which comes only by intuition unless it can be learned by experience.

When the establishment of an electric lighting and power plant has been decided upon, many points must be considered, among the first of course being the choice of a site for the general works. Then comes the system of generation and distribution to be adopted, which is determined usually by the magnitude of the installation. One thing to be borne in mind is that the undertaking should be so designed and carried out that not only shall it be a financial success in later years but that it shall pay its way from the very first and at every stage of its development.

One of the greatest faults with many stations is, that they have been designed on too small a scale, and have to have extensive alterations and replacements after a few years have elapsed. On the other hand there have been cases where a plant has been built on too large a scale, causing in some cases complete failure to the project and in others, years of operation for which there has been no remuneration.

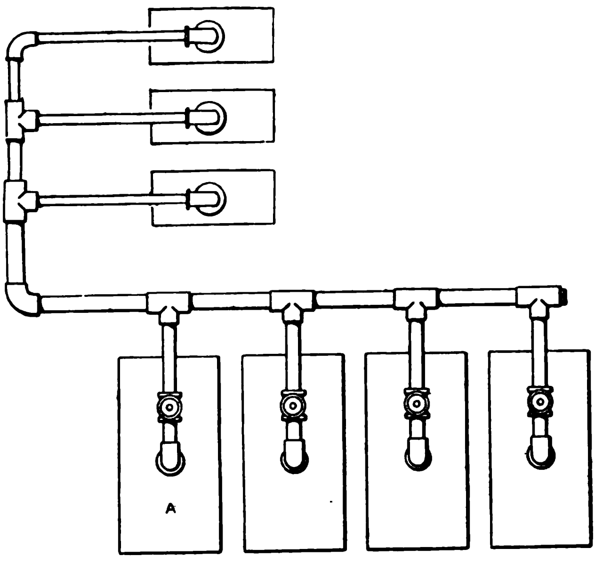


FIG. 1. PLAN OF PIPING NOT TO BE RECOMMENDED.

It is much wiser to lay out a small plant that will yield a good return on the capital invested than it is to sink a large sum in machinery, a large portion of which stands idle for some years and not be able to cover working expenses. In such a case it is evident that the plant itself defeats any possibility of reducing the cost of electricity to a price that would be a popular figure, because of the extra machinery that must be kept up.

An electric light plant should be so designed, that reliability and a constant supply can be maintained as this more than anything else will secure a good demand for the products of the plant. For this reason duplicate steam mains from the boilers to the engines are advocated, duplicate units both of engines and dynamo, duplicate boiler feeds and other auxiliaries and a spare boiler, should be considered although it means an increased expenditure. These precautions, however, are well worth the money, and the cost will be as nothing, compared with the actual money damage that the cessation of the service for a few minutes, occasionally, or even voluntarily several times in the course of a year will amount to.

The choice of site and the system of supply to be adopted are so closely connected that it is a difficult matter to consider them independently of each other. It is usually an impossibility to choose the site for a generating station with reference to the engineering considerations alone. When it comes down to everyday practice it will be found that there are only several sites available, and a decision has to be made by weighing the advantages and disadvantages of each. It is very seldom that the ideal location is found, but wherever the site is, it will be possible to select an efficient system, even though it may not be perfectly ideal.

The system of distribution to be selected depends upon the size of the district. For the plant which is to supply a small area where the low pressure from the station is available an effort should be made to secure a site as near as possible to what may be termed the center of distribution, *i.e.*, the point around which the greatest demand for energy radiates. When the area is so extended that it cannot well be served with a low pressure current, then a high pressure current must be considered.

No matter what system of generation is adopted the following points are important: First, accessibility for the delivery of coal and removal of ashes, delivery of machinery and stores, connections to main wires, proximity to water to be used for condensing purposes and for boiler feeding. Then another point to be considered is the matter of stability of the foundation of the building, engine setting, etc., together with an isolation to secure freedom from liability of causing a nuisance by noise, vibration, smoke, dirt, etc., and above all a facility for extension if such is required.

The cost of carting fuel from the car to the plant often causes a surprising difference in the cost of fuel, even when the distance is only a few miles. Without doubt the most advantageous position for an electric or other steam plant is adjoining a railroad from which a siding can be taken to the plant, thus giving a greater choice of coal from different mines, than would otherwise be the case.

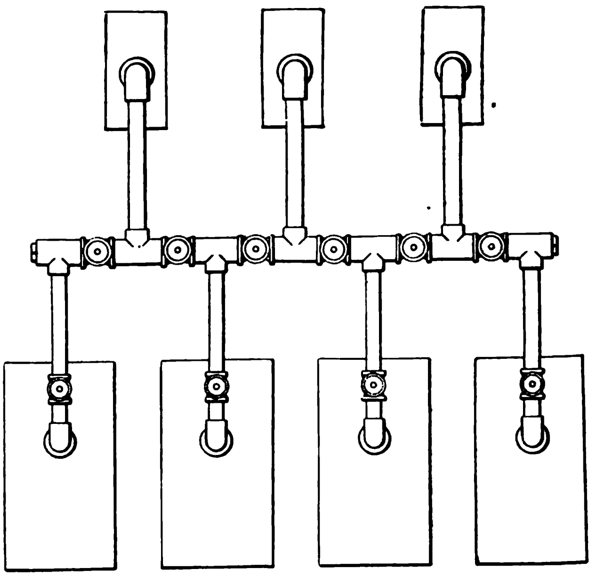


FIG. 2. THE PLAN OF PIPING WHICH ALLOWS OF SEVERAL COMBINATIONS BETWEEN ENGINES AND BOILERS.

Water supply in large quantities is a necessity because no great measure of success can be looked for unless it is possible to employ condensing engines. To be sure the water cooling tower can be utilized

.ly a limited amount of water is available, but it to install and maintain, and is liable to become nce through escaping steam. The quantity : is of not so much importance as the quality, e any kind of water can be used to advantage lensing purposes, the water used in the boilers)e free as is possible from hardness and scale properties.

s one of the dangers which must be provided when a plant of any kind is being built, as :h cheaper to install a system for fire protection ›eginning, than to do so after the plant is in n. It is also of importance that the system be : and most up-to-date, although the actual loss is the least the manufacturer fears. It)ss of business through interruption which is ınd which is the natural outcome of a fire.

apparatus for quickly extinguishing a fire e composed of the following equipment. Water ould be connected with the city or town water nd run through the building, having numerous from which a supply of water may be drawn, ıe regular attachments for hose, having in ad- he regulation fire hydrants on the streets. ould be scattered throughout the building and suitable supports for immediate use. In ıstances the hose is hung in little cupboards ncases the hydrant to which the hose is al- nnected and this protects it from injury and nother means of protection is by installing a team pump which is regulated automatically, which steam is always up. This keeps the ı commission and ready for instant service in fire.

may be different methods of providing for a ıpply. About the best is to have a reservoir the pump, having a capacity equal to keeping) supplied for at least half an hour when it is ; at full speed. A valve connecting the tank ty supply should be arranged so as to be able the supply in the reservoir from being ex- in this simple way an inexhaustible supply of .n be obtained.

oil house where the oil supply is kept every-)uld be constructed of brick, concrete or iron, fire starts it will be confined to that building.)f sand is a most convenient thing to have n case a fire starts while any one is in the oil

plant a precaution against fire can be taken lying several covered metallic cans for the of receiving greasy waste, etc. This will ı disastrous fire from spontaneous combustion waste and other greasy material, because if it e fire it will burn itself out in the box and do ge.

ard to the system of generation there can be ion whatever as to the superiority of direct d units over the belt or rope driven, as it is icient, more reliable and much safer. They he upkeep, and reduce the floor space required mallest possible amount, which in many in- ıs is one of the important features to con-

speed, both high and low speed plants have cellent results, probably for small continuous current machines up to 200-kilowatt capacity, a saving in the cost of the dynamo is effected by running at a high speed, but for larger machines the saving is much reduced. Taking large power units of from 1,500 to 4,000 kilowatts, a slow running plant is probably the cheaper.

In alternating current plants, a slow speed is suitable for a considerably larger size. Some doubt appears to exist as to the adaptability of high speed engines, but there is no reason why this should be. A strong point of the best known high speed engine is the small amount of tension required while running, and for small stations there can be little doubt that it is the most suitable whether the current generated will be of the continuous alternating or not. High speed engines may be used to advantage in stations where the units do not exceed 500 indicated horsepower. Above this size, however, the slow speed engine is preferable.

Another important initial consideration in designing a station is in determining the size of generator. The factors governing this are the total capacity of the initial installation of the plant, the ultimate probable capacity of the station and the percentage of overload considered necessary as a reserve. It is also important to estimate correctly the size of plant required during the first stage of operation of the undertaking. This should cover a period of about three years, as it would be manifestly wrong to be obliged to make an extension before the end of the first year.

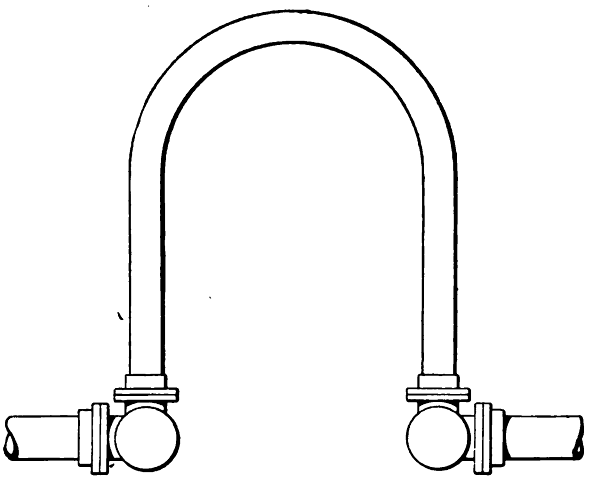


FIG. 3. U LEG CONNECTION BETWEEN ENGINE AND BOILER.

Assuming that the total initial capacity has been correctly judged, the point to settle is among how many generators shall the output of the station be divided. This is usually determined by the percentage of reserve considered necessary, and by that alone. The condition is this, that if one machine breaks down, the remainder shall not be overloaded more than a given amount. Thus if the permissible load be 25 per cent than five machines should be provided, if 20 per cent six, and in this manner the size of the first machine can be decided.

As the size of the engine capacity is increased, it is also proper to increase the size of the boilers, but this increase cannot be carried on to any such extent, and the maximum size will vary considerably with the type of boiler. When a large number of boilers are employed, the ground space occupied will of necessity be very great, but this will not be of very great moment if the cost of the land is low. There is a serious disadvantage other than the cost of the land, as with the boilers covering a large area, there is the piping to consider, and long steam pipes are a disadvantage. This causes great loss from radiation and waste of heat, together with difficulties in connection with expansion and contraction of the pipes.

Large boilers have the advantage of being compact and having less parts to maintain, such as valves, etc., which are a constant source of expense. The boiler should be as large as possible in a station of considerable size, but in smaller stations it must be determined by the capacity of the plant. A size should be selected so that one boiler can be cut out for cleaning or repairs without reducing the capacity.

The location of the boilers and their connection to the engines has been taken up elsewhere in this issue.

The efficiency of the steam plant depends to a great extent upon the skill used in the construction and design of the pipe system. It is a mistake to depend upon one line of piping to supply the engine or engines with steam. It is obvious that to depend upon the tightness of every joint on a steam pipe line month after month and year after year, is absolute folly, as repairs must be made and to make them there must be some means provided to allow of its taking place without stopping a portion of the plant. The essential point is therefore, to provide a pipe system which will admit of every valve and joint being made good without interrupting the supply of steam to more than a very small fraction of the plant, and also that the failure of any portion of the pipe system shall not involve even a momentary interruption of the operation of the plant.

Fig. 1 illustrates three engines being supplied by four boilers. The boilers are connected to a main steam pipe each succeeding boiler connecting to a larger pipe, the largest section being between the boiler *A*. and the first engine, the pipe reducing as each engine is reached. In this case it is evident that if any thing happens to the steam main between the boiler *A*, and the first engine, all of the engines will be put out of commission, while repairs are being made.

Fig. 2 shows a better arrangement, because in the case there is no call for a pipe line larger than the branches to the engines. There are also enough valves in what might be called the header to permit the cutting out of any section in case of damage, thus allowing for almost any combination of engine and boilers.

A good method of taking care of the expansion and contraction in the piping between the boilers and the headers is shown in Fig. 3. where the U leg is made as long as possible. It is of course necessary to drain both sides of the U. Another thing to arrange is for the support of the piping at intervals so that the pipe shall be free to move. Keep as much of the piping in the boiler room as is possible. This not only keeps the engine room cooler, but reduces the risk of damage in case the piping bursts.

STEAM PLANT PIPING.

The piping of high pressure steam has been brought to a point of successful operation during the past 25 years. There are more problems connected with steam piping than the average engineer realizes unless he has studied the subject. This is not only true of high pressure piping, but applies to ordinary practice of 100 pounds or less steam pressure per square inch, as well. We can also include the piping for steam heating, water pipes and the almost numberless branches to fill the various requirements.

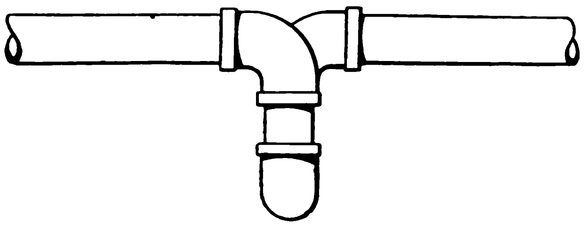


FIG. 1. SWIVEL JOINT.

In order to connect up the line of piping so as to obtain satisfactory results, one must understand the rules for determining the sizes of the mains and branches. Quite frequently an engineer, especially if he has had but little experience with piping, does not know how to compute the sizes of pipe to meet the requirements in either low or high pressure work. Neither does he understand how to lay out the piping using expansion joints. Improperly providing for the expansion and contraction of pipes probably causes more trouble than anything else connected with piping. One method of avoiding this trouble is by using what is known as the swivel joint shown in Figs. 1 and 2, which shows that any lengthening of the pipe *P* will be taken up by a slight turning or swivel movement at the points *B* and *C*.

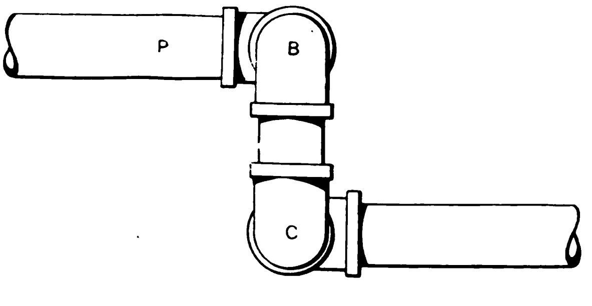


FIG. 2. ANOTHER TYPE OF SWIVEL JOINT.

Long bends are often used in high pressure work and make the best arrangement possible. Such a bend is shown in Fig. 3.

Fig. 4 shows the connection between the boiler and drum with a long bend pipe. From the drum the connections to the engines are with long bend pipes similar to the ones shown in Fig. 3.

Another way in which a bend pipe may be used is shown in Fig. 5. In this instance the steam pipe is laid under the flooring, coming up through the floor on one side of the cylinder and by making an easy bend connects with the steam chest on the other side. The throttle valve is operated by means of the stand wheel as shown. This does away with all of the overhead piping and the annoyance of the dripping water from leaky joints. It also presents a neat appearance and is convenient in many ways.

Several types of expansion joints which are manufactured, are illustrated in Figs. 6, 7 and 8. The one in Fig. 6 is known as the screwed traverse expansion joint, both ends being fitted with female connections.

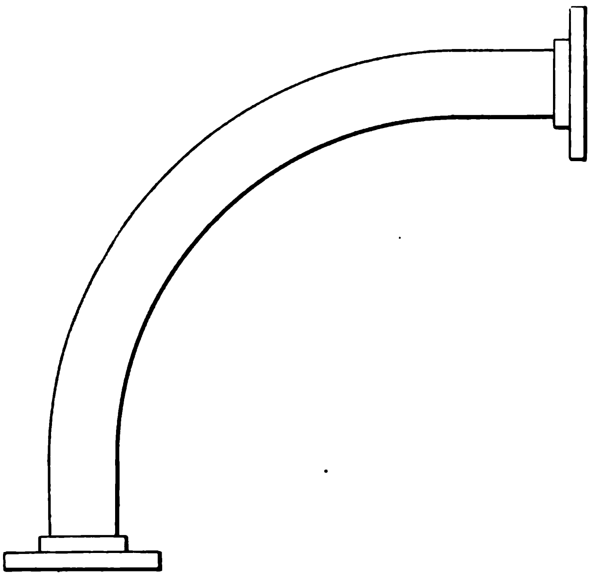


FIG. 3. ORDINARY LONG BEND.

In Fig. 7 the same design of expansion joint is shown with the exception that it is fitted with a flange instead of a screwed joint. Pipe expansion will average about 1 inch in every 50 feet of piping.

Fig. 8 shows an expansion joint which is sometimes used in the exhaust pipe, when the diameter is large. The movement in this case is taken up by the copper diaphragm *D. M.*

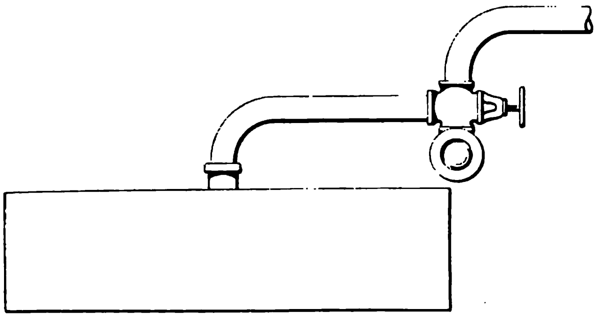


FIG. 4. LONG BENDS CONNECTED TO HEADER.

Strange as it may seem wrought steel piping which has become so reliable was not brought to a point of perfection until about 15 years ago, but today all an engineer has to do if he wants wrought steel of a standard size, is to order it while, if the specifications call for a larger size, it can easily be made for him. With the pressures now carried, pipes and their fittings and all material used in a first-class job are required to stand a working pressure of 200 pounds per square inch.

The opinions of constructing engineers have radically changed within the last 10 or 15 years, regarding the method and material used in the construction of steam pipe lines. Only a few years ago anything was good enough for a pipe line, but today as much consideration is shown to that part of the steam plant as to any other. A modern high pressure steam job requires in the first place good design, good material and skillful workmen in putting it up, and the latter requirements should never be changed although the first may be made to suit the individual conditions of each plant.

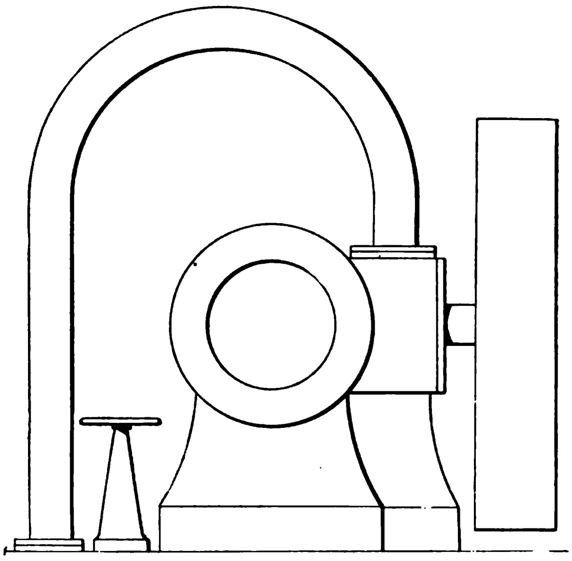


FIG. 5. LONG BEND FOR ENGINE STEAM PIPE.

Until about 15 years ago the universal design for a piping system was to carry a pipe from each boiler into a large steam header which was figured to have a cross section equal to the area of all the feeding pipes. Sometimes the header was made considerably larger without any real object in view. From this header, pipes were carried to the various engines, the size depending upon what was called for by the engine

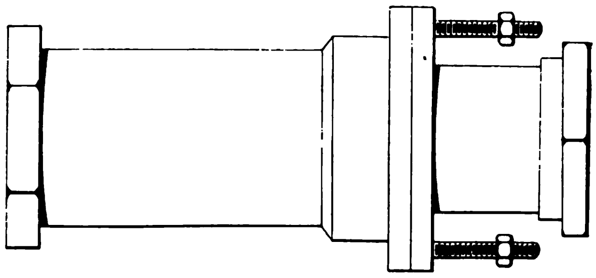


FIG. 6. SCREWED TRAVERSE EXPANSION JOINT.

builder. As a general thing steam separators were placed in each steam pipe leading to an engine. With high pressure and superheated steam the size of the pipe has been very much reduced. It is very seldom that the largest steam mains of the present time are over 20 inches in diameter and pipes of this kind are usually used more as an equalizing pipe than for storage reservoirs.

It is not an uncommon practice in some of the best steam plants to have the pipes running from a header to the engines, two sizes smaller than that called for by the engine builder. In such cases these pipes before reaching the engine are carried into a wrought iron or steel receiver having a cubical capacity of about three times that of the high pressure cylinder. This receiver is placed as near the cylinder as possible; it also acts as a separator. The pipe from the receiver to the cylinder is the size called for by the engine builder. This arrangement provides for a full supply of steam close to the throttle which cushions the blow caused by the cutting off in the steam chest, and thus prevents any vibration from being transmitted through the piping system. It also produces a steady and rapid flow of steam in one direction only by having a small pipe leading into the receiver. This steam flow should be rapid enough to make good the deficiency caused during the first quarter of the stroke. With this arrangement plants may be successfully run where the drop in steam pressure is not greater than 4 pounds, although the engines may be at a distance of from 400 to 500 feet from the boilers. In such cases as this, allowance should be made for contraction and expansion by providing long bends and using swivel joints as shown in Figs. 2, 3 and 4. In this method the fittings turn on the threads of the nipple and produce what may be called internal tension.

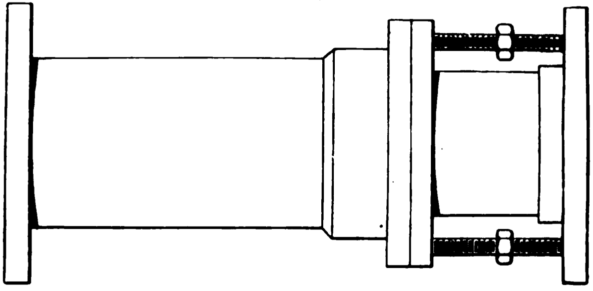


FIG. 7. FLANGE TRAVERSE EXPANSION JOINT.

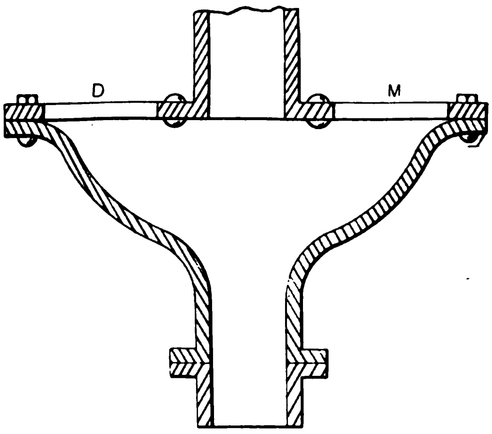


FIG. 8. EXPANSION JOINT FOR EXHAUST PIPE.

At present the material for piping used is either wrought steel or wrought iron and the flanges are either riveted, screwed or welded.

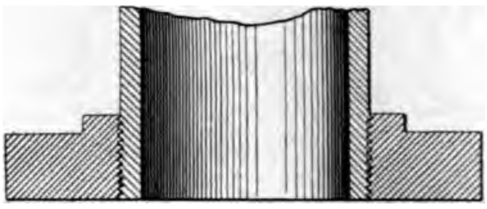


FIG. 9. HEAVY SCREWED FLANGE.

For a number of years the makers of flange fittings and valves each had their own standard for diameters of flanges, bolt circles, and number and size of bolts. But in 1894 they mutually agreed that all flanges carrying steam pressures up to 125 pounds should be called standard and should be uniform as to diameter and thickness, diameter of bolt circle and number and size of bolts. On June 28, 1901, they further agreed that all heavy flange fittings carrying up to 250 pounds working pressure should be uniform on the above named points. The bolt circles, size and number of bolts are now uniform in all fittings regardless of the maker unless ordered otherwise.

The diameters of flanges and templates for drilling up to 250 pounds working pressure as adopted by the leading manufacturers are shown below.

FLANGES AND TEMPLATES FOR DRILLING.

Size. Inches.	Diameter of Flanges. Inches.	Bolt Circle. Inches.	Number of Bolts	Size of Bolts.	Length of Bolts.
1	4½	3¼	4	½	2
1¼	5	3¾	4	½	2¼
1½	6	4½	4	⅝	2½
2	6½	5	4	⅝	2½
2½	7½	5⅞	4	¾	3
3	8¼	6⅝	8	⅝	3
3½	9	7¼	8	⅝	3¼
4	10	7⅞	8	¾	3½
4½	10½	8½	8	¾	3½
5	11	9¼	8	¾	3¾
6	12½	10⅝	12	¾	4
7	14	11⅞	12	⅞	4
8	15	13	12	⅞	4¼
9	16	14	12	⅞	4½
10	17½	15¼	16	⅞	4¾
12	20	17¾	16	⅞	5
14	22½	20	20	⅞	5¼
15	23½	21	20	1	5½
16	25	22½	20	1	5¾
18	27	24½	24	1	6
20	29½	26¾	24	1⅛	6¼
22	31½	28¾	28	1⅛	6½
24	34	31¼	28	1⅛	6¾

The preceding table gives the size of the pipe in inches, diameter of flange in inches, bolt circle in inches, number of bolts, size of bolts and length, from pipes 1-inch in diameter up to 24. Flanges, etc., are drilled in multiples of four so that fittings may be made to face in any quarter the hole straddling the center line.

One very essential point in the pipe line and one which is often overlooked or neglected is to have high pressure fittings or extra heavy fittings of the smaller connections, as a break in a small pipe such as the gage lubricator or the high pressure drip connections, would cause inconvenience and possibly a shut down Every pipe should be drained of the water of condensation in some manner. The best method, however. has been a matter open to question. Some engineers believe it is a better and cheaper way to draw it off through traps and discharge it into a hot well, and pump it back into the boilers with other feedwater. Others think it best to run it directly into the receiver of a pump and force it back while very hot. The latter is doubtless the better method in the majority of cases.

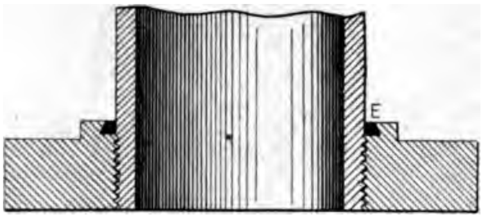


FIG. 10. SCREWED FLANGE HAVING CALKING RECESS.

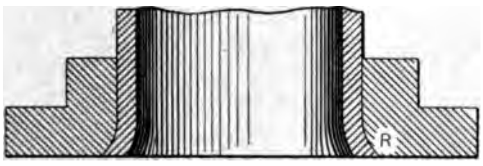


FIG. 11. FLANGE AND PIPE SHRUNK TOGETHER.

In Fig. 9 is shown a type of heavy flange which is designed for working pressures up to 250 pounds. It is what is known as the extra heavy screw flange, in which the flange and pipe are threaded, the pipe being threaded into the flange so that the end extends through when the face of the flange and end of the pipe are turned off true.

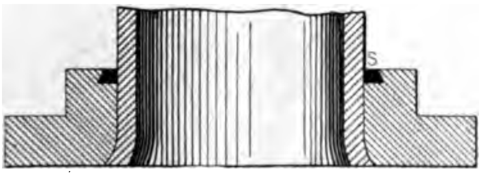


FIG. 12. SHRUNK FLANGE HAVING CALKING RECESS.

Fig. 10 shows another method of securing the pipe, which is the same as Fig. 9, with the exception that a calking recess is provided as shown at *E*, in the flange. Fig 11, is an illustration of a flange joint showing the pipe and flange shrunk together and firmly peened into the recess shown at *R*, the end of the pipe being turned off true. Fig. 12 is the same kind of a flange joint with the exception that the flange has a calking recess on the back at *S*.

Fig. 13 illustrates a shrunk flange reinforced with bosses on the back of the bolt holes, while Fig. 14 shows a back view of the flange and bosses.

A joint which has met with considerable favor from engineers of high pressure plants is illustrated in Fig. 15. This flange shows the pipe and flange welded together, making practically one piece.

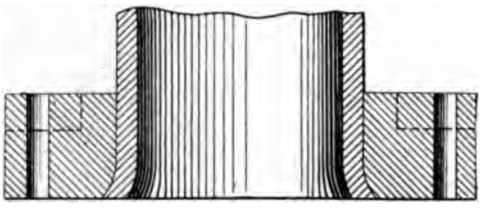


FIG. 13. FLANGE HAVING REINFORCED BOSS.

Fig. 16 shows a flange having a joint made by rolling or expanding the pipe in the recesses in the flange as shown. The strength of a joint made in this manner is limited only by the strength of the material, and it is almost impossible to force the flange off the pipe. This method, however, is not satisfactory unless the very best quality of piping is used.

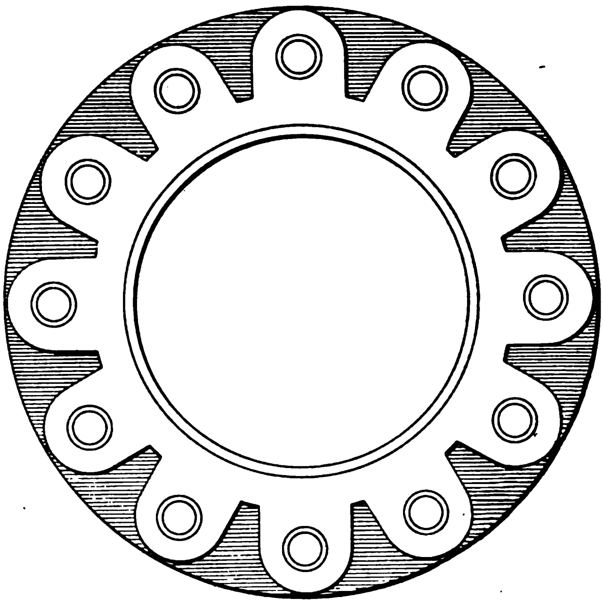


FIG. 14. BACK OF FLANGE BOSS.

In Fig. 17 is shown a quarter bend with flange attached to each end. Fig. 18 is a U bend with flange attached, while Fig. 19 is an offset bend having flanges attached at either end. In bending pipe the radius of any bend should not be less than five diameters of the pipe, while a longer radius is much preferable. The length *L* of the straight pipe at each end of the bend should not be less than shown in the following table:

$2\frac{1}{2}$ and 3 in pipe *L* equals 4 inches.
$3\frac{1}{2}$ and 4 inch pipe *L* equals 5 inches.
$4\frac{1}{2}$ and 5 inch pipe *L* equals 6 inches.
6 inch pipe *L* equals 7 inches.
7 inch pipe *L* equals 8 inches.
8 inch pipe *L* equals 9 inches.
10 inch pipe *L* equals 12 inches
12 inch pipe *L* equals 15 inches.
14 inch pipe *L* equals 16 inches.
15 inch pipe *L* equals 17 inches.
16 inch pipe *L* equals 20 inches.
18 inch pipe *L* equals 22 inches.

A form of flange face is shown in Fig. 20, on which the upper flange *T* is threaded. The lower one is threaded also, but has a calking recess. The faces of the flanges, however, are plain.

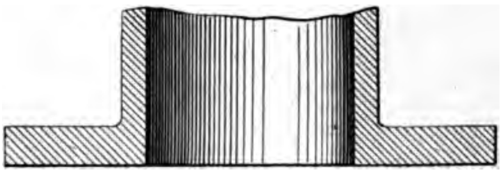


FIG. 15. FLANGE AND PIPE WELDED TOGETHER.

Fig. 21 shows a threaded flange having a male and female face, while Fig. 22, shows a tongue and groove face, *U* being the grooved female side. The flange shown in Fig. 21, is a type very generally used, the gasket being placed in the female portion of the flange, which tends to prevent it from blowing out as would be liable with the kind of gasket required. Fig. 22 is also designed so that the flange is protected against blowing out.

Steam pipes may be divided into a number of classes such as the main steam pipe connecting the boiler and engine, boiler feed pump, steam pipe, exhaust piping for the engines and steam heating systems together with piping of other auxiliaries.

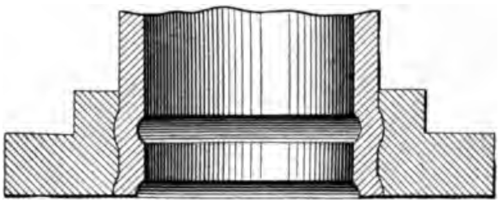


FIG. 16. FLANGE HAVING ROLLED JOINT.

The main steam pipe is a very important part of the steam plant equipment and its failure is surrounded by many possibilities of disastrous consequences. It should be proportioned so as to deliver the required amount of steam at the given pressure, with a minimum loss of pressure in the transmission. The loss in pressure is due, with steam flowing through a pipe, to the resistance of the pipe walls, bends and fittings. Another loss is due to the radiation which, to a certain extent, cannot be prevented.

Steam traveling through a pipe f
to the engine should not travel

per minute, therefore in order to calculate the size steam pipe, formula No. 1, is used.

$$d=D\sqrt{\frac{S\times r\,p\,m}{36{,}000}}$$

In this formula *d* equals internal diameter of stea pipe in inches, *D* equals diameter of engine cylind bore in inches, *S* equals piston stroke of engine inches, *r. p. m.* equals revolutions per minute.

In using this formula it is assumed that steam fc lows the piston throughout the entire stroke while i reality it is cutoff at a quarter stroke or wherever th engine happens to be cutting off, when there is a ce sation of flow until the admission occurs at the oth end of the cylinder. In fact the flow of steam throug the end of the pipe opening into the cylinder is a pu sation of greater or less frequency, all depending upo the rotated speed of the engine. In order to secu sufficient capacity the pipe is usually made large enoug to supply the engine if it should take steam full strok

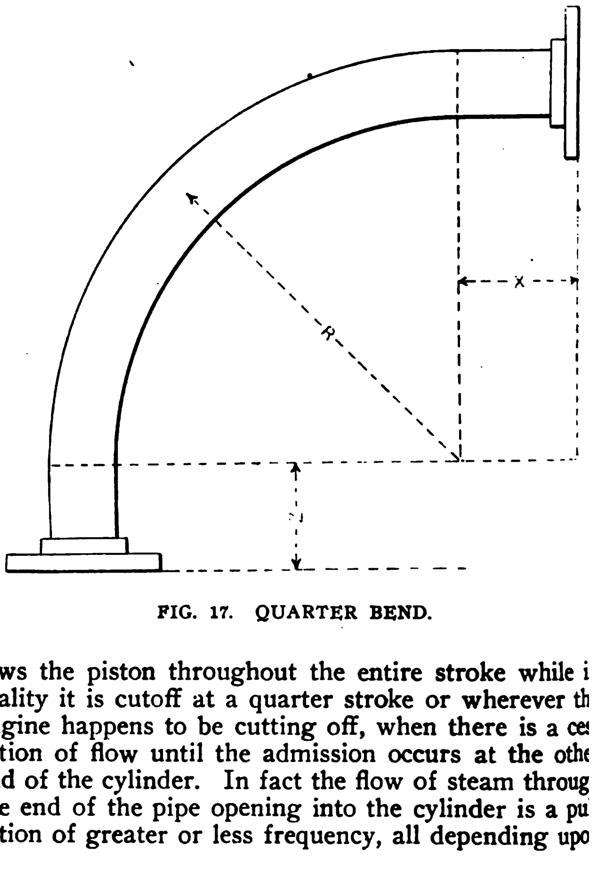


FIG. 17. QUARTER BEND.

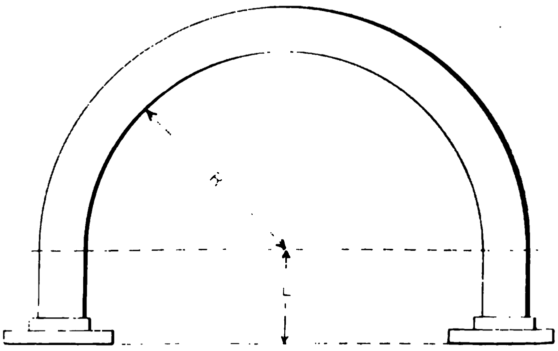


FIG. 18. U BEND FLANGED AT BOTH ENDS.

With some engines wire-drawing of the steam du admission is experienced, especially if the engi king a large number of revolutions per minut

When this occurs it causes a decided downward drop of the indicator card on the steam line instead of the horizontal line so frequently found in cards taken from slow speed engines. To avoid this a receiver is placed in position near the cylinder as has already been stated which brings about a more uniform pressure during the admission period of steam to the cylinder, but the initial pressure in the cylinder will be less than the boiler pressure in any case. This is brought about by the resistance to the flow of steam offered by the pipe and the various connections. The drop of pressure, however, varies directly as to the length of the pipe. A large steam pipe will offer less resistance than a small pipe of equal length, all other conditions being the same.

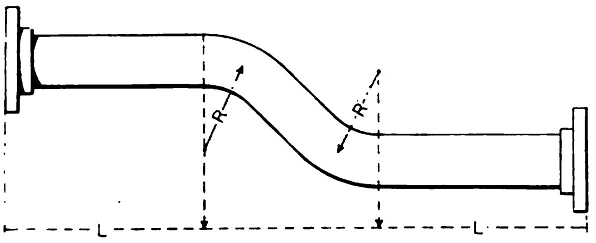


FIG. 19. OFFSET BEND.

Quite frequently it is desired to know what loss of pressure may be expected in a steam pipe of given length and diameter when the initial pressure and amount to be discharged is known. To determine this, formula No. 2, may be used.

$$p' = \frac{W^2\ L\ K}{7{,}500{,}000{,}000\ w}$$

p' equals loss of pressure in pounds per square inch. W equals discharge of steam in pounds per minute, L equals equivalent length of pipe in feet, w equals weight of a cubic foot of steam at a given initial pressure in pounds and $K = \dfrac{1 + \frac{3.6}{d}}{d^5} \times 1{,}000{,}000$

This formula may be used to calculate the diameter of the steam pipe when the initial pressure, the allowable drop in pressure, the length of pipe and the quantity to be discharged are known. It may also be used to determine the discharge from a pipe under certain known conditions. One should remember, however, that whenever the discharge pressure becomes as low as 58 per cent of the initial pressure the weight of steam discharged in a given time becomes a maximum and no further lowering of the discharge pressure will increase the flow.

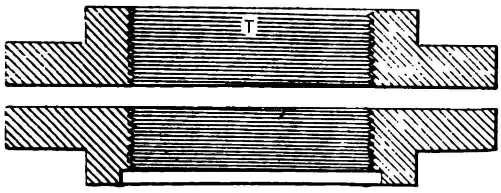


FIG. 20. PLAIN FACED FLANGE.

In exhaust mains the velocity of a flow of steam should not be over 40,000 feet per minute, therefore the formula for exhaust piping will be the same as formula 1 with the exception that 24,000 is used in place of 36,000, or $d = D\sqrt{\dfrac{S \times r\,p\,m}{24{,}000}}$ the letters in this formula having the same meaning as in formula 1.

In looking at pipe connections it is frequently found that whoever has superintended the job has not put the work in as it should be; for instance, in the case of three or four boilers connected to the same steam line it is evident that boiler 1, will require a pipe only large enough to carry away the steam generated in that boiler. The pipe between boiler 2 and 3, however, must be large enough to convey the discharge from both boilers and the area of the section between boilers 2 and 3 should be twice as large as the section of piping between boilers 1 and 2, while the area of the pipe between boilers 3 and 4 must be three times that between the boilers 1 and 2. The pipe leading from all four boilers must be four times that of the first section. This would bring the diameter of the last section of pipe twice as great as the diameter of the first section. This arrangement of pipe is not a very desirable one, the header system already mentioned being far more preferable.

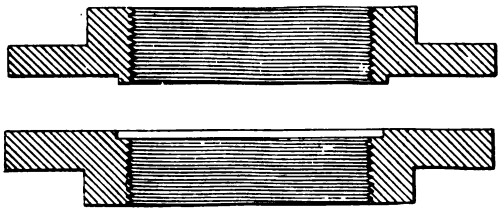


FIG. 21. MALE AND FEMALE FLANGE.

It is frequently desirable to know how many pipes of one size will be required to furnish the same amount of steam, water, etc., as a larger pipe of given size. At the same velocity of flow two pipes deliver as the square of the internal diameters, but the same heads will not produce the same velocity in pipes of different sizes or lengths, the difference usually being said to vary as the square root of the fifth power of the diameter. Experiments by different investigators have shown that the following formula will work out a close approximation to the relative flow in pipe of

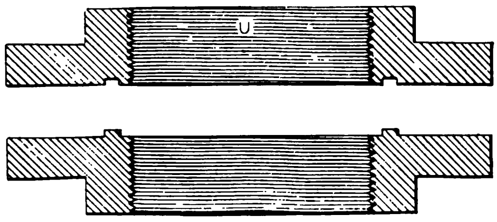


FIG. 22. TONGUE AND GROOVE FLANGE.

different sizes under similar conditions. The formula is, $W=\frac{d^5}{\sqrt{a+3\ 6}}$ *W* equals the weight of fluid delivered in a given time and *d* is the internal diameter in inches of the pipe. The diameter of standard steam pipe varies, however, from the nominal diameters and in applying this rule it is necessary to take the true measurements which are given in the following table.

TABLE OF EQUATION OF PIPES.—STANDARD STEAM AND GAS PIPES.

Dia.	½	¾	1	1½	2	2½	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Dia.
½		2.27	4.88	15.8	31.7	52.9	96.9	205	377	620	918	1,292	1,767	2,488	3,014	3,786	4,904	5,927	7,321	8,535	9,717	½
¾	2.60		2.05	6.97	14.0	23.3	42.5	90.4	166	273	405	569	779	1,096	1,328	1,668	2,161	2,615	3,226	3,761	4,282	¾
1	7.55	2.90		3.45	6.82	11.4	20.9	44.1	81.1	133	198	278	380	536	649	815	1,070	1,263	1,576	1,837	2,092	1
1½	24.2	9.30	3.20		1.26	3.34	6.13	13.0	23.8	39.2	58.1	81.7	112	157	190	239	310	375	463	539	614	1½
2	54.8	21.0	7.25	2.26		1.67	3.06	6.47	11.9	19.6	29.0	40.8	55.8	78.5	95.1	119	155	187	231	269	307	2
2½	102	39.4	13.6	4.23	1.87		1.83	3.87	7.12	11.7	17.4	24.4	33.4	47.0	56.9	71.5	92.6	112	138	161	184	2½
3	170	65.4	22.6	7.03	3.11	1.66		2.12	3.89	6.39	9.48	13.3	20.9	23.7	31.2	39.1	50.6	61.1	75.5	88.0	100	3
4	376	144	49.8	15.5	6.87	3.67	2.21		1.84	3.02	4.48	6.30	8.61	12.1	14.7	18.5	23.9	28.9	35.7	41.6	47.4	4
5	686	263	90.9	28.3	12.5	6.70	4.03	1.83		1.65	2.44	3.43	4.69	6.60	8.00	10.0	13.0	15.7	19.4	22.6	25.8	5
6	1,116	429	148	46.0	20.4	10.9	6.56	2.97	1.63		1.48	2.09	2.85	4.02	4.86	6.11	7.91	9.56	11.8	13.8	15.6	6
7	1,707	656	226	70.5	31.2	16.6	10.9	4.54	2.49	1.51		1.41	1.93	2.71	3.28	4.12	5.34	6.45	7.97	9.31	10.6	7
8	2,435	936	322	101	44.5	23.8	14.3	6.48	3.54	2.18	1.43		1.35	1.93	2.33	2.92	3.79	4.57	5.67	6.60	7.52	8
9	3,335	1,281	440	137	60.8	32.5	19.5	8.85	4.85	2.98	1.95	1.37		1.41	1.71	2.14	2.77	3.35	4.14	4.83	5.50	9
10	4,393	1,688	582	181	80.4	42.9	25.8	11.7	6.40	3.93	2.57	1.80	1.32		1.21	1.52	1.97	2.38	2.94	3.43	3.91	10
11	5,642	2,168	747	233	103	55.1	33.1	15.0	8.22	5.05	3.31	2.32	1.70	1.28		1.26	1.63	1.88	2.43	2.83	3.22	11
12	7,087	2,723	938	293	129	69.2	41.6	18.8	10.3	6.34	4.15	2.91	2.13	1.61	1.26		1.30	1.57	1.93	2.26	2.58	12
13	8,657	3,326	1,146	358	158	84.5	50.7	23.0	12.6	7.75	5.07	3.56	2.60	1.98	1.53	1.22		1.21	1.49	1.74	1.98	13
14	10,600	4,070	1,403	438	193	103	62.2	28.2	15.4	9.48	6.21	4.35	3.18	2.41	1.88	1.50	1.22		1.24	1.44	1.64	14
15	12,824	4,927	1,698	530	234	125	75.3	34.1	18.7	11.5	7.52	5.27	3.85	2.92	2.27	1.81	1.48	1.21		1.17	1.35	15
16	14,978	5,758	1,984	619	274	146	88.0	39.9	21.8	13.4	8.78	6.15	4.51	3.41	2.66	2.12	1.73	1.42	1.18		1.14	16
17	17,537	6,738	2,322	724	320	171	103	46.6	25.6	15.7	10.3	7.20	5.27	3.99	3.11	2.47	2.03	1.66	1.37	1.17		
18	20,327	7,810	2,691	840	371	198	119	54.1	29.6	18.2	11.9	8.35	6.11	4.63	3.60	2.87	2.35	1.92	1.59	1.36	1.16	
20	26,676	10,249	3,532	1,102	487	260	157	70.9	38.9	23.9	15.6	10.9	8.02	6.07	4.73	3.76	3.08	2.52	2.08	1.78	1.52	
24	42,624	16,376	5,644	1,761	778	416	250	113	62.1	38.2	25.0	17.5	12.8	9.70	7.55	6.01	4.92	4.02	3.32	2.84	2.43	
30	75,453	28,990	9,990	3,117	1,378	736	443	201	110	67.6	44.2	31.0	22.7	17.2	13.4	10.7	8.72	7.14	5.88	5.03	4.30	
36	120,100	46,143	15,902	4,961	2,193	1,172	705	319	175	108	70.4	49.3	36.1	27.3	21.3	16.9	13.9	11.3	9.37	8.01	6.85	
42	177,724	68,282	23,531	7,341	3,245	1,734	1,044	473	259	159	104	73.0	53.4	40.5	31.5	25.1	20.5	16.8	13.9	11.9	10.1	
48	249,351	95,818	33,020	10,301	4,554	2,434	1,465	663	363	223	146	102	75.0	56.8	44.2	35.2	28.8	23.5	19.4	16.6	14.2	
Dia.	½	¾	1	1½	2	2½	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

ACTUAL INTERNAL DIAMETERS.

This table gives the number of pipes of one size required to equal in delivery other larger pipes of same length and under the same conditions. The upper portion above the diagonal line of blanks pertains to standard steam and gas pipe, while the lower portion is for pipes of the actual internal diameter given. The figures in the table opposite the intersection of the two sizes gives the number of the smaller sized pipes required to equal one of the larger; thus 10, 3-inch pipes are equal to one 7-inch pipe.

Among lubricating oils, fine mineral oils stand first on the list of those which adhere well to metal surface, but are without perceptible molecular cohesion. Sperm oil stands second; neatsfoot third, and lard oil fourth. This is also the order of their fitness for use on machines.

Condensing engines require from 20 to 30 gallons of water, at an average low temperature, to condense the steam represented by every gallon of water evaporated in the boilers supplying engines—approximately for most engines, we say, from 1 to 1½ gallons condensing water per minute per indicated horsepower.

FOUNDATIONS AND CHIMNEYS.

The way in which foundations are constructed should receive most careful attention. We wish to emphasize that the foundation should be in proportion to the load, and the center of the foundation placed under the center of pressure. As long as a foundation can be depended upon to carry a weight it matters not so much what the masonry is made of provided it will hold together and form a heavy mass. It is possible to make the bed-plate of an engine massive enough to make any other foundation unnecessary, but this is not done, because there are other purposes served by a proper foundation outside of that of absorbing the action of forces in the engine.

In some instances the bed-plate of an engine rests upon a subbase of cast iron to which the bed-plate is bolted and the subbase secured to the foundation. The usual practice, however, is to have the bed-plate rest directly on the foundation.

The following are the accepted figures for the supporting power of different soils:

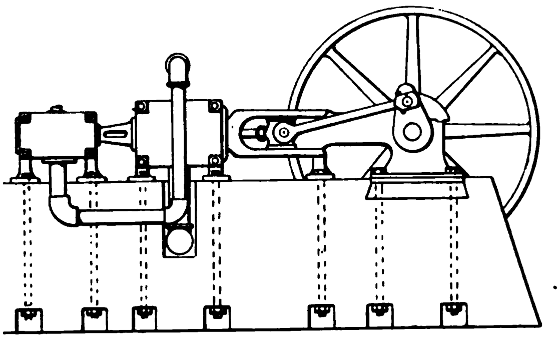
Alluvial soil from .5 to 1 ton per square foot.
Clay, soft, from 1 to 1.5 tons per square foot.
Clay, dry, from 2 to 4 tons per square foot.
Clay, thick, from 4 to 6 tons per square foot.
Sand, clean dry, from 2 to 4 tons per square foot.
Sand, compact, from 4 to 8 tons per square foot.

Gravel and coarse sand will support from 4 to 8 tons per square foot if protected from water, while hard rock in thick stratum will support a pressure of 200 tons per square foot.

An engine foundation must be far enough below the surface to escape frost, vibration, etc., which cause l settling. The depth necessary will, of course, ut there should not be less than 3 feet of founda- low the general level. The engine foundation greater strain brought to bear upon it than most , and it should have mass and weight sufficient l the engine against unbalancing forces which, case of a high speed engine more particularly, tendency to slide the engine lengthwise. The tion must also be of sufficient proportions to the vibration, if the bed-plate is not massive to do it alone. In cases where the foundation n rock and is not sufficiently massive, it has been that vibrations caused by reaction in the engine nsmitted almost perfectly to adjoining founda- n the same rock.

. Sweet in a paper, read before the engine build- ociation, stated that when this vibration is likely r, due to the foundation going down to rock, s two inches of sawdust under the foundation ound the sides which effectually prevents the on from being transmitted. The sawdust, he ill not rot so long as the air does not get to it.

foundations of large engines should be of cut or l masonry, according to the usual specifications, class work is to be had. Where the structure ts it, tunnels should be made or left through the tion by which access may be had to the lower f the bolts by which the bed-plate is bolted to the tion.



TANDEM COMPOUND ENGINE AND FOUNDATION SHOWING ANCHOR BOLTS AND TUNNELS.

1 shows an outline drawing of a tandem com- Corliss engine together with the foundation and s. For small engines, footings of rough masonry e used to distribute the pressure and upon this per foundation is built.

ther method is to make the foundation of one lock of concrete. With a vertical engine bed- it is very often not enough to provide for the tion of all vibration, and when such an engine en, if it does not call for an extended area in the tion, the only remedy to prevent the vibration is sufficiently deep to bring about the desired re- Sometimes this is inconvenient to do, and where found a special footing must be made to arrest ration.

way of preventing the transmission of vibration he use of sand when it can be kept dry and the tion block itself is of sufficient mass. When used the foundation pit is dug 2 or 3 feet deeper or 3 feet wider on all sides than the foundation itself is to be. The pit is then surrounded with proper sheathing to prevent the displacement of the sand, which is filled in 2 or 3 feet below the bottom of the foundation and then around it on all sides as it is built up. It must be remembered, however, that when the foundation block is not massive enough, this method only aggravates the difficulty it is intended to cure.

The foundation bolts should be strong in order to firmly hold the bed-plate and in a sense make the foundation and bed-plate one mass. These bolts, of course, vary in size with the size of the engine, but they should not be of smaller diameter than can possibly be twisted off with an ordinary monkey wrench, common diameters being from 1⅛ to 1½ inches. The largest engines require bolts 2 inches in diameter and upward. The length of the bolt will be determined in many instances by convenience, but it should extend a good way into the foundation, if not all the way to the bottom, in order that the upward strain may be distributed in the foundation as widely as possible.

The location of the foundation bolts are determined by the holes in the bed-plate which are generally so arranged that there are bolts at the cylinder end and at the crank shaft end as shown in Fig. 1. The bolts are built into the foundation and at such a height that when the foundation is completed, and the bed-plate placed upon it, the upper end of the bolts will protrude through the holes in the bed-plate enough to take a washer and nut on the upper end.

One method of doing this is shown in Fig. 2. The wooden frame is what is termed a template, having holes made through it at points which correspond to holes in the bed-plate. The template is adjusted to its proper height above the proposed foundation site, after the nuts are in place on the upper ends of the bolts as shown. The lower ends of the bolts are fitted with threads and nuts, on top of which rests the bearing plates, which cause the pull on the bolts to be borne by a number of bricks without danger of pulling through. The nut and thread permits of a vertical adjustment of the bearing plate.

Some engineers surround the bolts with a link of pipe in order to permit of a certain limited horizontal adjustment. The pipe is usually of such diameter that the bolt can be deflected. After the bolt is in place and the alignment completed, the space around the bolt on the inside of the pipe is filled with cement and the position of the bolt is fixed.

In Fig. 2, the template shows the bolts which are required for the outer bearing of the engine shaft attached to the principal template. This is the usual method of procedure when the drawings of the template are furnished by the engine builder, and it is desired to make the foundation all in one piece. When the length of the engine shaft makes it desirable to have a separate foundation for the outer bearing, it is usually more convenient to work with a separate or independent template.

Fig. 3 shows another view of a template in position, the line *A B*, which represents the center line through the engine is transferred to the template at *C* and *D*. When the lines *C* and *D* have been brought under and parallel to the line *A B*, the template will be in position, and as the bolts are hung from it the brick work (if brick is used) can be commenced. For obtaining the vertical plane through the cylinder, a line is stretched over the foundation pit and carried to suspended plumb bobs in the usual way. For laying off the center line of shafting, or wall lines a chalked line is used snapping it on the floor making the line in that manner. The centers of the shaft having been determined are transferred to the floor or plumb line, by a large T square, the head and blade of which should exceed 6 feet in length and the squareness of which has been carefully verified.

When the foundation is complete the bed-plate is then lifted upon it. This is a quick and not very difficult operation to perform when a crane is available for use. In case there is none, the bed-plate must be lifted by jacks and blocked high enough to clear the bolts, and then rolled into place and lowered by the successive withdrawing of the blockings, piece by piece.

After placing a bed-plate in position it may be found that the masons have not built the foundation with a perfectly level surface, such as the setting of an engine requires. It is therefore necessary to make a joint between the bed-plate and the foundation work which supports it.

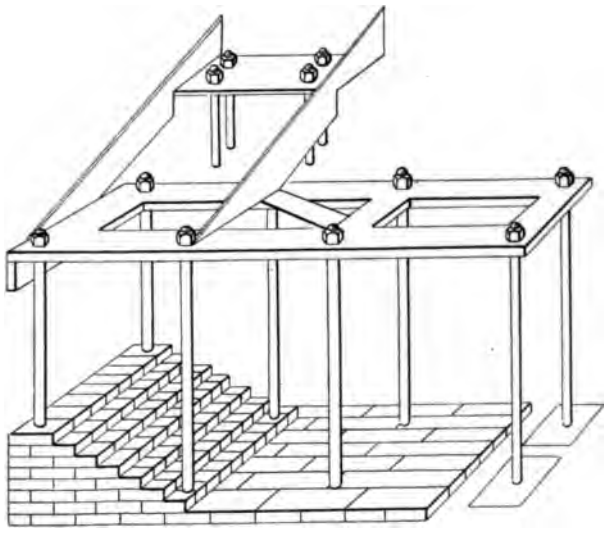


FIG. 2. TEMPLATE AND ANCHOR BOLTS IN POSITION FOR THE FOUNDATION TO BE BUILT.

This is made much easier when the masonry is covered by a cap-stone. In the absence of a cap-stone the bed-plate is lowered over the foundation and rests upon thin wedges which are placed on each side of the bolts between the bed-plate and the foundation. The nuts on the bolts are screwed home when the bed-plate is level, compressing the shims. By driving in or loosening the shims any warping of the bed-plate is prevented. The nuts should be tightened up until they refuse to go further.

The space between the bed-plate and the foundation should then be filled. There are several methods of doing this. The sulphur joint is the most widely used, and is made as follows. A clay dam is made around the bed-plate and the ordinary rolled sulphur melted in a kettle and poured into the joint between the bed and the masonry. As it expands somewhat as it becomes solid, it fills every space and gives full support to the bed-plate. It also has the advantage of not deteriorating from oil or vibration. The material used for foundations is usually brick and cement and in some cases cut stone, but the cost of the latter makes its use almost prohibitive.

Cobble stones have been used for filling in foundations with the exterior finished with cut stone or brick, but this does not give satisfaction, as the foundation will not settle evenly. Brick foundations have been used to a considerable extent and in recent years, cement and crushed stone has been largely adopted. A foundation of this kind can be constructed more rapidly than can a brick foundation and only requires that moulds be built, into which the concrete can be run, after which unskilled labor only is necessary for shoveling and tamping the concrete. When a thickness of about 8 inches is in place, it will require tamping. Another advantage in using concrete for foundations is that any form can be made, the only extra expense being that of making the mould. In making this kind of a foundation the concrete will harden into a solid mass if the surfaces which may have set, are freshened before new concrete is added.

It would perhaps be well to compare the advantages of the concrete foundation to those of the brick foundation. The brick foundation is a collection of separate bases held together by mortar which is more or less of a honey-comb nature and when built in the manner followed by some, is rather a rickety affair which will easily crumble. It has been estimated that the cost of brick foundations will average from $7 to $8 per cubic yard, while that of concrete will cost on an average from $6 to $8.

Concrete foundations have smooth even sides, and when finished with a layer of thin cement mortar, will be very easy to keep clean, while the brick foundation with its uneven surfaces is always ready to catch all kinds of refuse. Another desirable feature of the concrete foundation is that the corners can be rounded, as desired. Again the uniform mass of concrete will enable it to carry the pressure brought to bear upon it evenly, to all parts of the soil underneath, and makes unnecessary an underpinning upon which to construct the foundation.

Where broken stone is difficult to obtain, the use of brick for foundations is advisable, or if the foundation is small it may be better, as less preparation is required.

In building the engine and boiler room, the foundations may be constructed by digging down until the top layer of loose earth has been removed when the usual stone foundation can be built, upon which the brick walls of the building are to rest.

In building a chimney, the cost of the exterior staging is one of the largest items unless the later method of constructing the staging on the interior of the chimney is used, when the cost is almost a matter of no importance in comparison, when figured in with the total cost, and can be ignored almost entirely in the erection of large chimneys.

It is extremely essential that the material which is to go into the construction of a chimney be the best obtainable. The bricks to be used should be tested in order to ascertain if they are capable of withstanding the weight of the masonry together with the pressure of the wind. The concrete and sand should be tested from time to time and if found to be under the standard, condemned and thrown out.

Before beginning to excavate, borings should be made in order to ascertain the nature of the soil, which will determine its bearing capacity and the size of the foundation necessary to properly distribute the load.

A good proportion of concrete cement is, 1 part Portland cement, 2 parts sand and 5 parts broken stone, deposited in layers of 8 inches thick.

In the construction of a chimney the shape of the interior has considerable to do with both the cost and the capacity. A chimney having a round flue offers less resistance to the passage of the gases than one built square, but a round chimney inside and outside will cost more than any other form, and will also be the best. This applies to any kind of chimney whether constructed of brick or of steel.

While the first cost of a round chimney is greater than an octagonal or square chimney, the cost for repairs will be far less as the chimney ages. Then again, a round chimney need not be as high as one of another shape in order to obtain the same draft. Therefore the first cost of a round chimney is partly offset by the reduction in height. The same effect can be obtained by building the outside square and the inside with a round flue. This will of course reduce the cost of construction and not affect the draft.

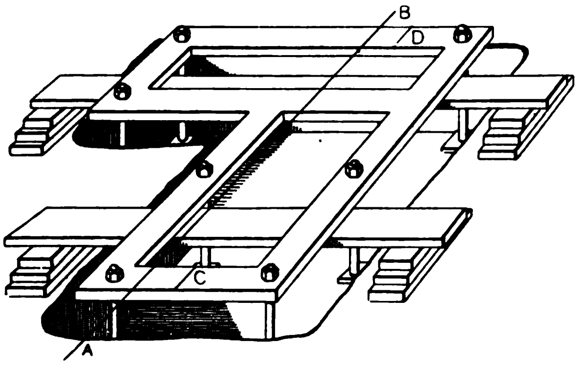


FIG. 3. ANOTHER METHOD OF PLACING THE TEMPLATE AND ANCHOR BOLT.

The height of a chimney will vary with the kind of fuel used. For instance, if wood is to be used, a stack having a diameter of say 3 feet will require a height of 48 feet. If bituminous coal (slack) is used, the same chimney should not be less than 126 feet in height. It is well to build a chimney with the idea of burning a poor grade rather than a high grade of coal, so that the chimney will always be of ample capacity.

Following is a table which will give a good estimate of the height of a chimney for different kinds of coal:

Height of Chimney for Different Kinds of Coal.

	Height in diameter.		
Kind of fuel.	Maximum.	Minimum.	Mean.
Bituminous, lump	25	16	21
" egg	30	18	24
" nut	38	21	27
" pea	46	27	36
" slack	54	30	42
" run of mine....	42	24	33
Semi-bituminous, run of mine	50	28	39
" " lump	46	20	33
" " slack	52	30	41
Anthracite, egg	36	22	29
" pea	43	24	34
" very fine	63	33	48
Wood	19	13	16

The above is applicable to a large number of plants where the conditions for obtaining a good draft with a chimney of moderate height are not exceptionally good or exceptionally bad, and where the fuel is neither of the poorest or of the best quality of the several kinds mentioned. To find the height of the chimney, multiply the combined area of the boiler tubes by 1.3; in a table of areas of circles find the corresponding diameter and multiply it by the figures given in the above table according to the kind of fuel used.

A brick chimney should be located at a point where it will be available for connecting additional boilers in case more are needed. With iron stacks the same principal applies, although the cost of moving the latter from one position to another is far less than in the case of a brick chimney.

With steel or iron the enormous amount of brick and cement used in the construction of brick chimneys is eliminated, as is the increased cost of a solid and massive foundation. For this reason the use of the metal chimney is favored by many engineers. A steel stack will not crack if the foundation happens to settle a trifle, while the brick stack may.

Metal chimneys are built with or without fire brick lining, depending upon the temperature of the escaping gases, and when a lining is used, the thickness depends upon the diameter and height of the chimney.

A ladder should be provided, preferably on the outside of the stack, for use should any examination or repairs be required in the future. A manhole having an iron door and frame should also be fitted in the base of the stack for examination, cleaning and repairs.

A large stack is usually located outside of the building, having a horizontal pipe connecting with the boilers, and as a general thing is supported by a brick foundation reaching about as high as the top of the boiler house. This not only gives the metal stack a solid foundation, but allows for alterations and repairs to the stack without disturbing the smoke uptake which enters the brick portion of the stack. This is a far better method than that of having the stack rest upon the boiler front with the accompanying disagreeable feature of water trickling down the sides of the stack into the boiler room. In cases where the stack is set directly above the boilers, extending up through the roof and being held in place by iron guys, it is impossible to make the roof tight. The stack must be fitted to the roof, if it is constructed of wood, loosely, on account of danger from fire; if the roof is of slate, gravel or tin, it is not practicable to make a tight joint, as the working of the stack by the wind would soon cause the roof to leak. For this reason a hood is secured to the stack which in a measure prevents the water from coming down the stack into the fire room; but unless the hood is kept in good order at all times it soon becomes leaky.

Steam engines, in economy, vary from 14 to 60 pounds of feed water and from 1½ to 7 pounds of coal per hour per indicated horsepower.

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches or a column of water 33.9 feet high at sea level.

THE STEAM TURBINE.

The steam turbine is by no means new to the readers of this or other journals, as turbine plants and different types of turbines have been described more or less frequently during the past two years. The steam turbine for many reasons makes an ideal engine and will be much used in the future. Those not familiar with its construction wonder how so much power can be developed in a machine occupying so little space; for instance a 5,500-kilowatt turbine, the largest in the world, and its generator have an extreme length of 47 feet 3 inches while the width including the generator is only 16 feet ,and the height only 14 feet. When these figures are compared with those of the reciprocating engine it will be seen that the difference is in favor of the turbine. Such a turbine can be operated with a maximum overload of about 13,000 horsepower, giving an average of over 17 horsepower for each square foot including the generator.

The steam turbine contains many ideal features; for instance the cost of the foundation is small, in the majority of cases being a little stronger than is necessary to hold the weight of the turbine and such a thing as anchor bolts are unknown. The foundations for the 1,000-kilowatt turbines of the Cleveland-Southwestern Traction Co. at Elyria, Ohio, which were described in the November issue of the Engineers' Review, consist merely of two longtitudinal walls, each turbine foundation being constructed of concrete about 1 foot wide. This makes an ideal location for the condensers which are placed between the walls.

The turbine is a machine by which the energy of a moving fluid may be directly transformed into mechanical energy of rotation. When a difference of pressure exists between two connected points of a fluid which is allowed to move, motion between those two portions must follow and by causing a moving fluid to act on a number of blades arranged around the rim of a wheel, the wheel may be made to do mechanical work by revolving . It may be said that the laws which govern the design and form of the buckets and passages of the water turbine are equally applicable to steam turbine practice. The difference lies in the fact that steam is elastic while water is not and steam being a much less condensed medium than water, attains a much higher velocity.

If steam is generated in a closed vessel, the pressure will increase as the quality of steam increases and as the volume cannot change the heat absorbed is all used in increasing the internal energy of the steam, therefore its temperature rises. We know that if the temperature of a given quantity of gas be kept constant, its volume varies inversely as its pressure. When gas under pressure expands, particles are set in motion and this work is done by the heat energy which the gas or steam possesses and the temperature of the gas consequently falls.

The phenomena of the steam jet is getting to be more generally understood, although it has until lately been surrounded with considerable mystery. The function of the nozzle is to direct a jet of fluid in a particular direction with the greatest velocity possible. With the steam jet the steam must be thoroughly expanded within the nozzle so that the energy due to the expansion of the steam may be utilized in giving the jet the maximum velocity.

So much has been written of late regarding the turbine that engineers who are keeping abreast with the time understand its operation. The thing that is of interest to them now is, what are the advantages of the steam turbine over the reciprocating engine? There seems to be a general impression that the steam turbine is adapted only for use with a high steam pressure. This is perhaps due to the fact that the turbine is particularly economical when operated with high steam pressure. Contrary to this impression, however, the turbine will operate with an economy as great as that of the reciprocating engine under comparatively low pressures when running condensing.

With the 1,250-kilowatt steam turbine installed by the Interborough Rapid Transit Co. of New York was given a contract guarantee with provisions that with 175 pounds steam pressure at the trottle, and 27 inches vacuum, measured by a mercury column and referred to a 30-inch barometer, the consumption of steam at various loads should not exceed the following: With dry steam at full rated load 15.7 pounds per electrical horsepower per hour; ¾ load .16.6; ½ load, 18.2; and ¼ load, 23.2. With steam superheated 75 degrees F. the steam consumption at various loads should not exceed the following: Full rated load 13.8 pounds, per electrical horsepower; ¾ load, 14.6 pounds; ½ load, 16.2 pounds; ¼ load, 20.8 pounds.

In the test which followed after this machine was installed the steam consumption when saturated steam was used was considerably better than the guarantee, the difference at full load being 7 per cent of the guaranteed steam consumption. This was obtained with steam of only 147 pounds pressure, instead of 175 pounds specified in the contract. With superheated steam at the same pressure the test showed an economy that was so close to the guarantee that the difference was hardly perceptible.

A reciprocating engine with the usual cutoff gear is most economical at about ¾ of the full load rating; the steam consumption is considerably greater at full load and increases rapidly with overload. With the turbine, however, the highest economy is preserved at about full load, and through a considerable range of overload. The operation, during the peak loads, may be accomplished without the loss of efficiency occurring in the turbine. When comparing the steam consumption of the steam engine with that of the turbine, it is customary to think of engine economy as steam consumption for indicated horsepower rather than brake or electrical horsepower. The indicator, however, does not reveal engine or generator losses while in this turbine test both are included in the figures of steam consumption. The most marked economy for the turbine when compared with the reciprocating engine occurs at light loads. A test of a certain four-valve compound engine, fitted with reheating receiver and steam jackets, shows this to be so. The engine showed a maximum economy at about 700 indicated horsepower, but at half load the water rate had increased 24 per cent, while at 1,000 indicated horsepower it was only 7 per cent. There is a constant loss with the best designed machines, and brake tests show that the friction losses at heavy loads are but slightly greater, due to greater pressures on the various parts. In generator tests the increase in loss from full load to ¼ load is less than ½ per cent of the rated capacity. Comparing the performance of the steam engine and the turbine under discussion we find that the increase in steam consumption in the turbine at half load is but 4.6 per cent and at overload decreases rather than increases.

In considering the relative merits of the steam turbine and modern compound condensing engine we are bound to compare the first cost. The first cost of a steam turbine is less than a reciprocating engine of the same capacity. The reciprocating engine requires an expensive foundation and occupies in many instances valuable space that could be used for other purposes. The saving in favor of the turbine in first cost is from 20 to 30 per cent which includes the electric generator and all auxiliary machinery, the condensing apparatus excepted. There is also a saving in the foundation, land and building, as well, as less floor space is needed, The turbine has in its favor, a higher economy due to a higher thermal efficiency; a reduction in the cost of maintainance, due to its simplicity of construction; a reduction in the cost of attendance; a saving in oil and boiler feedwater by the use of a surface condenser.

Those who object to the turbine claim that the steam consumption will probably increase with time. This, however, is the opinion of engineers who do not understand that the velocity of the steam is very low and that cutting of the blades does not occur. This is not a theory but has been proven by the examination of blades that were in use for more than 10 years. If the vanes do not wear there will be no decrease in the efficiency of the turbine with advanced age. With the reciprocating engine this cannot be said, as every day there is some wear to the internal parts of the engine, which will eventually lead to leakage and loss.

The cost for repairs and maintenance of the turbine is remarkably small when compared with the reciprocating engine, as the only parts to wear are the bearings which at all times are flooded with oil and lightly loaded; the wear, therefore, has been exceedingly light. The turbine is free from the fault known as hunting which is evident in so many reciprocating engines. In power plants supplying current to street car lines where the load fluctuates from the beginning to the end of the run and is often subject to sudden changes, especially in the smaller power plants, the turbine has the advantage, as sudden changes in the load do not affect it as they do the reciprocating engine. There is no danger from broken pistons or cylinder heads caused by flooding the cylinder, for the turbine will, in most cases, slow down when flooded, and after the water is discharged will resume its normal speed again without damage to its internal parts. There are conditions, however, where the flooding of the turbine with water will injure the revolving vanes.

We know of a recent case in which the turbine received a charge of water with the result that quite a number of the vanes were broken. No other injury was apparent as the pieces of loose vanes lodged between the stationary vanes, and the turbine operated the same as before although the efficiency was reduced.

The breaking of the vanes was caused by the sudden contraction due to the difference in temperature between the superheated steam and the water from the boiler. The circumstances were somewhat out of the ordinary, considering the conditions under which the flooding occurred. In this instance the baffle plates of the boilers were down, allowing the heat to pass direct from the furnace to the superheater. This heated the steam to about 200 degrees superheat, which was 100 degrees more than ordinary. This, in itself, would not have caused any damage to the turbine, but the fireman allowed the water to get too high in the boiler. It is doubtful if the flooding of the turbine would cause disastrous results if the steam were not superheated above 100 degrees.

Another feature of the turbine is that it may be started at a moment's notice and in less than half a minute be running at full speed. With the reciprocating engine, 10 minutes is about the limit. This is important if a machine is required in an emergency.

It has already been shown that in every-day practice, the turbine is about as economical in the use of steam as the most economical and best of reciprocating engines. There are conditions, however, under which this is not true. The economy of the turbine over the reciprocating engine,—this refers to units of 500 kilowatts and over,—is due largely to the fact that the turbine can make use of a higher vacuum than the reciprocating engine; in other words, the reciprocating engine in order to utilize a vacuum of 28 inches, which is the vacuum usually carried with turbines, would require a low pressure cylinder of twice the size of the present cylinder used with 26 inches of vacuum. The reason for this is that the volume of a given weight of steam at 28 inches of vacuum is twice that of the same weight at 26 inches of vacuum, and an addition of an inch or two of vacuum means a considerable saving in steam per kilowatt hour.

With the turbine a very high vacuum is necessary in order to maintain either its economy, or its capacity. To obtain a high vacuum, especially with a heavy load and with warm weather and warm water, with a condensing apparatus of practicable size, has been found to be rather difficult.

A good vacuum is of the greater importance in turbine practice, and to maintain a high vacuum, all air leaks must be avoided. With the turbine this is comparatively easy as there is no chance for air leaks, except where the spindle comes out of the cylinder, and the leakage there will be steam rather than air.

Another thing is necessary, *i. e.* a condenser of sufficient area and plenty of cooling water, and provisions for removing the air that may leak into the condenser. The amount of water required for condensing the steam from the turbine is 50 times the full load consumption, which increases the vacuum under normal conditions about 1 inch over that obtained when using the usual allowance of 30 times the steam consumption.

Taking every thing into consideration there is no doubt but that the turbine in actual practice is a decided success when used with electrical generating machinery.

When the turbine is used for alternating current it is cheaper than a compound condensing Corliss unit, but when direct current is employed and direct distribution is possible, the cost of the generating apparatus would undoubtedly make it more expensive than the Corliss. It is evident from what we know of turbine practice that the steam turbine should be rated at its highest capacity. At that point it gives its best efficiency and is able to carry a 50 per cent overload by means of a bypass. Steam turbines are built to stand as a whole, a somewhat larger overload than the better class of reciprocating engines.

From what has been written regarding the condensing apparatus for the steam turbine, one would naturally get the idea that they require a more expensive condensing equipment than the reciprocating engine. This, however, is not necessarily so, for the turbine can be operated with the same vacuum, but as a higher vacuum is so much more economical the more expensive apparatus is in the end the cheaper.

As a general thing 28 inches of vacuum is demanded, using surface condensers with two stage air pumps and every means of increasing this performance. With such apparatus it is evident that the cost of the high vacuum equipment is considerably more than that usually supplied for reciprocating engines requiring 25 to 26 inches of vacuum.

Surface condensers are commonly used, although no particular type is especially recommended for steam turbine requirements. The main feature is that of placing it as close to the turbine as possible, using a centrifugal circulating pump which is operated in connection with a siphon system of water piping and air pumps, either of the two-stage dry air type, or of the Edwards type. Such an equipment as this is estimated, when the amount of piping required is included, to cost not less than four times as much as a modern condensing system suitable for a first class reciprocating engine central plant.

In a paper read by Mr. Bibbins at a recent meeting of the American Street Railway Association in St. Louis was given some data in regard to the steam consumption of steam turbines when run noncondensing, which was most interesting and instructive. The figures given were the result of a test made on a 750-kilowatt Westinghouse-Parsons turbine, operating with 150 pounds boiler pressure and with various degrees of superheat. His figures show that slightly above full load and with dry saturated steam the consumption was about 28¼ pounds per brake horsepower. The steam consumption varied from 28 pounds per horsepower per hour at half load to 23 pounds at full load with steam superheated 100 degrees F. and 23½ pounds per horsepower per hour at 50 per cent overload with 28 inches vacuum and dry steam. The consumption at full load was 13.8 pounds per horsepower per hour as compared with 28.3 pounds when running noncondensing. . This shows a most remarkable reduction by operating condensing.

His figures further show that with 28 inches of vacuum and 100 degrees superheat the consumption was reduced to 12½ pounds per horsepower per hour. While the reduction in steam consumption with the reciprocating type of engine might be quite as much or even greater by means of superheating, it is doubtful that such a reduction could be secured by the addition of condensing apparatus even though it were capable of holding a vacuum of 28 inches. From Mr. Bibbins' figures it would seem that a steam turbine plant operating noncondensing is able to show results which compare favorably with those obtained from reciprocating engines running noncondensing.

The figures given in this same paper shows that the increase of cost of condensing apparatus for obtaining a high vacuum above the cost of an apparatus capable of getting 28 inches vacuum, is 60 per cent increase for a 28-inch vacuum and 100 per cent increase for 28½ inches. It also shows that with 26 inches of vacuum the per cent of saving due to an added inch is about 2.8. At 28 inches of vacuum the per cent in saving due to an additional inch is 5.7. It is obvious that although the cost runs up rapidly as the vacuum is increased, the percentage of saving effected also increases very rapidly.

We have already said that the surface condenser is usually used with the steam turbine and although no particular design is specified there seem to be three condenser systems which are favored. The one we have mentioned consists of a surface condenser, a centrifugal hot well pump, an air cooler and a single cylinder vacuum pump. Another system is the same as the foregoing, but is varied by omitting the hot well pump, the air cooler and dry vacuum pump and substituting the wet vacuum pump of which the Edwards type seems to be preferable. In either of the above systems the cost per kilowatt capacity is from $7 to $10. There is another system which is like the first with the exception that there is an elevated jet condenser with barometric tubes and hot well which take the place of the surface condenser and hot well pump. This latter has an advantage over the surface condensing system as it takes up less floor space and costs from $5 to $6 per kilowatt. With this type of condenser is used the dry vacuum pump which requires a two cylinder air pump, but the exhaust steam from the turbine cannot be used again in the boilers.

Another type of condenser which may be used with the steam turbine is the injector or ejector condenser. This type of condenser costs when fully installed with circulating centrifugal water pumps, valves, tank piping, etc., from $2 to $2.50 per kilowatt capacity and the cost is much reduced if there is a natural head of available water. This system is not largely used, however.

An important factor in securing high vacuum is to eliminate, as far as possible, friction in the exhaust piping leading from the turbine to the condenser. In all condenser arrangements an independent atmospheric exhaust outlet with a relief valve should be provided for each unit as in the case of a reciprocating engine, so that if the vacuum is lost the turbine can continue operation noncondensing.

Considerable speculation can be indulged in as to the exact field that the steam turbine will occupy, but we can rest assured that it has come to stay. For years the DeLaval turbine has been used for small powers of from 20 to 300 horsepower with good results, although in smaller units economy has been a secondary matter. It is evident, however, that the single stage turbine of 500 horsepower and over is not economical. The multi-stage turbine in sizes of from 200 to 1,000 kilowatts has shown itself durable, reliable and economical when operating condensing with a high vacuum and will run noncondensing or with a low vacuum, although the economy will be much lower.

For units of 5,000 kilowatt we have what is known as the four-stage turbine, but what the expense and upkeep will be after a few years of service is not known. It is extremely doubtful that a great revolution in stationary practice will be brought about for some time to come because of the advent of the turbine into the engineering field. The four-valve type of engine although a commercial success in every respect have not vanquished the high speed single valve engine, and it is doubtful that the turbine will supplant the reciprocating engine for noncondensing work, at least for very large installations. Great advancements will be made in steam turbine practice in the future, but to what extent no man can tell.

CONDENSER.

The condenser is one of the most necessary and important auxiliaries of the low pressure engine, as upon the perfection of the vacuum, produced in it by the condensation of the steam, depends the economy of the engine. It is evident that if the back pressure upon the engine piston be removed, the engine will not only be aided by the removal of a pressure of 14.7 pounds per square inch on the exhaust side of the piston, but the exhaust steam from the cylinder will be against no pressure, and the steam can be expanded in the cylinder to nearly absolute zero of pressure and its full expansive power be obtained.

The gain in power by the use of a condenser may be estimated on the basis of an increase of 12 pounds per square inch to the mean effective pressure in the cylinder. Therefore it will be seen, that with the aid of a condenser, the horsepower of an engine can be materially increased over that which is available when running noncondensing. Sometimes the vapors are to be condensed at atmospheric pressure, but more frequently it is desired to produce and maintain a vacuum by means of the condensation, in which case it must naturally be effected in a vessel shut off from the air.

The condensation of steam is accomplished by the use of cold water, or in some instances cold air. It may be done in two ways; either the cool water is injected directly into the steam to be condensed or the vapor is conducted over surfaces cooled by water or air. Thus we have what is known as the jet condenser and the surface condenser. The jet condenser is cheaper than the surface condenser and is usually used in stationary work. With the jet condenser an air pump must be used. The jet condenser is built in two different forms, known as the wet condenser, from which the air pump extracts the condensed steam and injection water together with the air and uncondensed vapors, and the dry condenser, from which the air pump extracts only the air and uncondensed vapor while the condensed vapor and injected water are carried off automatically in another way.

The surface condenser usually requires a large surface and is made square or tubular in form and is constructed with an outside casing in which are placed a large number of short tubes. The vapor passes through the tubes with the cooling water on the outside. An opposite arrangement is also used. An external view of the surface condenser is shown in Fig. 1, in which the water enters the condensing chamber at one end and flows through one bank of tubes into a chamber at the opposite end and then back again out of the top into the discharge pipe.

The steam enters the condensing chamber at the top where the current is divided by a baffle plate, which sends the steam in both directions and distributes it more evenly over the cold tubes where it is condensed, the temperature of the tubes being the same as that of the circulating water passing through them. The condensed steam collects at the bottom of the condensing chamber and flows into the suction pipe of the air pump, which also removes the air and aids in maintaining the vacuum. This type of condenser has the steam cylinder placed between the air and circulating pumps, the pistons of all three being connected to the same piston rod.

The surface condenser is particularly desirable where the condensing water is unfit for use in the boilers and for this reason it is used more largely for marine than stationary work. The surface condenser furnishes a reliable means for measuring steam consumption of an engine because the discharge of the air pump in a given time represents exactly the quantity of water required by the engine in the same length of time.

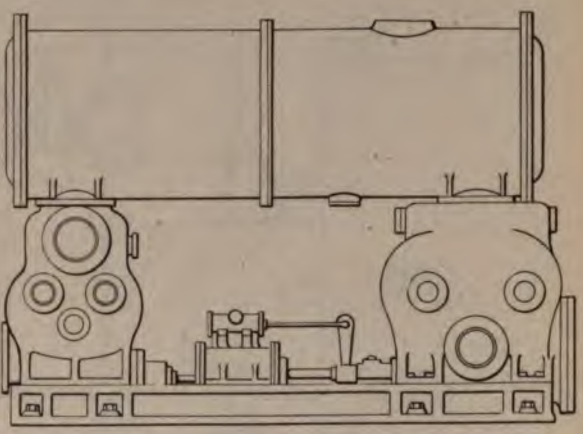


FIG. 1. SURFACE CONDENSER SHOWING POSITION OF AIR, STEAM AND WATER CYLINDERS.

In building surface condensers there is not much uniformity as to size, but a certain amount of cooling surface must be provided and the objection to a small condenser is, that in case the air pump fails to operate properly the condenser soon becomes choked with water. The capacity of a circulating pump for the best class of surface condenser when used with a compound engine, is about 1 to 22, or 1 cubic foot of circulating pump capacity to every 22 feet in the low pressure cylinder, and about 1 cubic foot of circulating pump capacity to every 588 feet of cooling surface in the tubes of the condenser. The proportion of cooling surface in the standard surface condenser is about 28 square feet to 1 cubic foot in the low pressure cylinder or 6½ square feet to the indicated horsepower.

Fig. 2 shows a surface condenser connected to an engine, heater, etc.

Fig. 3 shows an independent jet condenser in section. In this condenser the steam and water cylinders and valves are the same as in the ordinary direct acting pump; in fact it is a direct acting pump with a simple condensing chamber connected to the pump suction, which resembles to a great extent the air chamber on the ordinary pump, except that it is larger and is provided with an inlet for exhaust steam and an outlet for the condensing water.

The inlet for the water is carried down to the spherical part of the condensing chamber, and terminates in a cone shaped spiral device as shown. This throws the water out in a film against the side of the chamber, while the exhaust steam which enters above the spray cannot reach the pump below, without passing into the spray of cold water, which condenses it. The mixture of condensed steam and injection water is then drawn into the pump and discharged into a hot well. The injection water is regulated by means of a hand wheel, which extends up to the top of the condensing chamber and regulates the position of the cone at the end of the water inlet.

The jet condenser as a rule is provided with a device for breaking the vacuum. This is a very good feature, as it will prove a means of safety, if the water rises to a certain height in the condensing chamber, which it may sometimes do when the engine is lightly loaded, for it will cause the engine to exhaust into the air. If this were not done the water would be drawn back into the cylinder, which would undoubtedly wreck it.

A device for breaking the vacuum is shown in Fig. 4. It consists of a simple float connected to an air valve on the side of the condensing chamber. When the water rises high enough to raise the float, air is admitted into the condensing chamber and the vacuum is destroyed. When this occurs the exhaust steam from the engine flows out through the atmospheric valve into the atmosphere and the engine is changed to a noncondensing engine automatically, without stopping.

The capacity of a jet condenser may be from 1-15 to 1-20 the capacity of the steam cylinder, or it may be of the same capacity as the air pump.

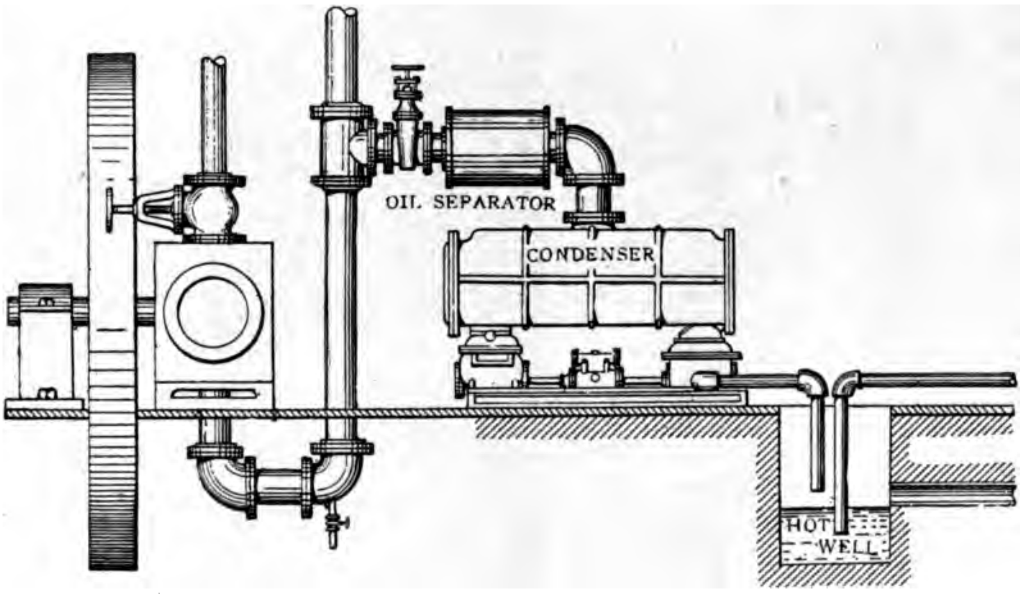


FIG. 2. SHOWING SURFACE CONDENSER CONNECTED TO AN ENGINE.

Fig. 5 shows the arrangement of piping where the jet condenser is used. In this case the exhaust pipe from the engine passes to a feedwater heater and from there on to the condenser, which is located below the cylinder of the engine. A bypass pipe is connected between the pipe leading to it and the one leading from the heater, so that the heater may be used or not, as desired. The exhaust pipe to the air is connected in next to the condenser so that in case the vacuum breaks the steam will exhaust into the atmosphere. With this arrangement the engine may be run either condensing or noncondensing and either with or without the feedwater heater. If it is desired to use a portion of the discharge water for feeding the boilers a grease extractor should be placed in the exhaust pipe between the engine and the condenser.

In a jet condenser the condensed water comes in direct contact with the steam, so that the temperature of the discharge is likely to be lower than that of the condensed steam in a surface condenser, if the water supply is not carefully adjusted. On this account there is likely to be less saving of heat from using the discharged water from a jet condenser than from a surface condenser, for feeding boilers. Fig. 6 shows another way of connecting a jet condenser to an engine, heater and pump.

Another type of condenser is what is known as the siphon condenser and is shown in Fig. 7. This type of condenser is doubtless the simplest form in use at the present time and operates as follows: the exhaust steam enters the condensing chamber which is somewhat contracted, through the cone shaped nozzle, while the condensing water enters at the side and surrounds the cone. The water issues into the chamber below through the annular orifice, between the cone and the walls of the condensing chamber. This causes the water to move at a high rate of speed and expels the air from the exhaust pipe. The steam upon leaving the cone shaped nozzle, flows into the inverted cone formed by the film of water which condenses the steam.

The condensed steam and the injection water then flow at a high velocity down through the contracted neck where the stream is solidified. It then passes on to the hot well. It will be seen that the neck of the condensing chamber is contracted, which forms a combining tube for the purpose of producing sufficient velocity in the water to maintain a siphon-like action which draws the steam from the exhaust pipe and causes a vacuum to exist. From the hot well, condensed water is taken by the hot well pump, and forced into the cooling tower, from which it falls to the cold well at the bottom, provided such is the arrangement of the plant. This style of condenser should be placed 30 feet above the level of the water in the hot well.

The siphon condenser will raise the condensation water to a height of from 15 to 18 feet, so that when the water supply is located within that distance of the top of the condenser, no pump is required, as the condenser will siphon the water over as long as steam is condensed.

When the condenser is operated without a pump a starting pipe is necessary. This is connected with the tail pipe and is shown in Fig. 8. When starting the condenser, the valve in the starting pipe should open and the water flowing through this and down the tail pipe gradually forces the air from the upper part until a sufficient vacuum is formed to draw the water up to the condenser and start the water going through it. Then the valve in the starting pipe may be closed.

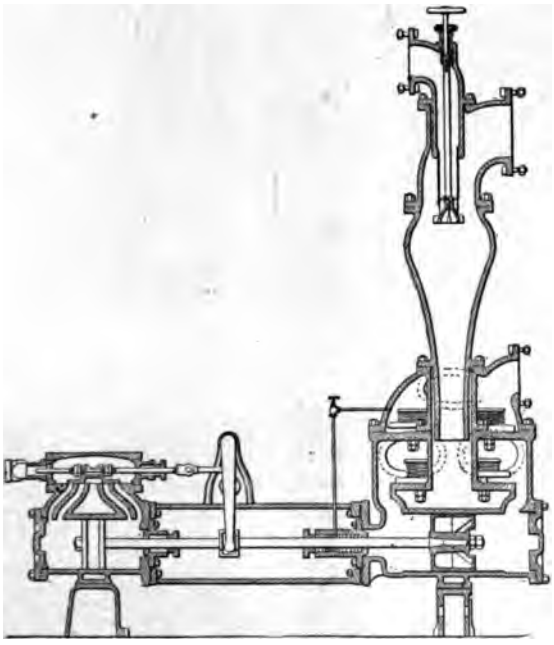


FIG. 3. SECTIONAL VIEW OF INDEPENDENT JET CONDENSER.

Fig. 9 shows a method of connecting a siphon condenser with the engine, the water coming from the cold well and being forced up into the condenser by a pump as shown. In the siphon condenser it frequently becomes necessary to destroy the vacuum and stop the engine on short notice. For this reason an automatic relief valve is placed at the top. This is necessary in cases where the condenser is arranged to siphon the water, because any failure of the condenser, with a light load, would result in the water being drawn into the low pressure cylinder, which would wreck the engine.

If it is desirable to use water from the hot well for feeding the boilers, an oil extractor should be provided to remove the oil from the exhaust steam, as with the jet condenser. Even with this precaution the supply to the boiler feed pump should be taken at a point considerably below the water level in the hot well. It will be seen that the siphon condenser has no moving parts whatever and nothing to get out of order. It is adapted to engines of all sizes and under all conditions.

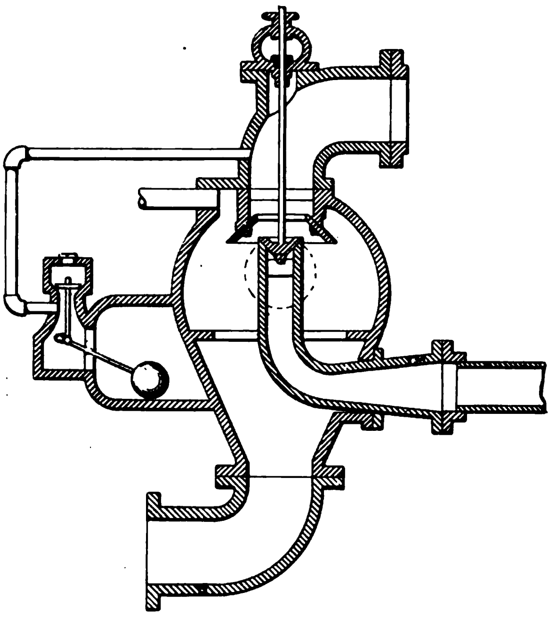


FIG. 4. VACUUM BREAKER ON JET CONDENSER.

As the aim of the condenser is to increase the efficiency of the steam engine, it is evident that the higher the vacuum maintained, as far as practicable, the greater the efficiency. There are cases where this is not true. These are mentioned later on. As the vacuum is formed by removing air from the exhaust pipe and connections as well as the condenser itself, it is evident that if there is an air leak in any way, the vacuum will be destroyed. Such leaks should be carefully stopped.

Without doubt the greatest source of air leakage is through the stuffingboxes, on both the engine and condenser, as well as on the valves in the pipes leading to and from the condenser. Another cause of air leakage is the excessive vibration of the engine on its foundation, and such air leaks will affect the vacuum to a serious extent. One method of testing for leaks in the exhaust and condenser piping is to hold a light close to the joints. If there is a leak the light will be drawn in.

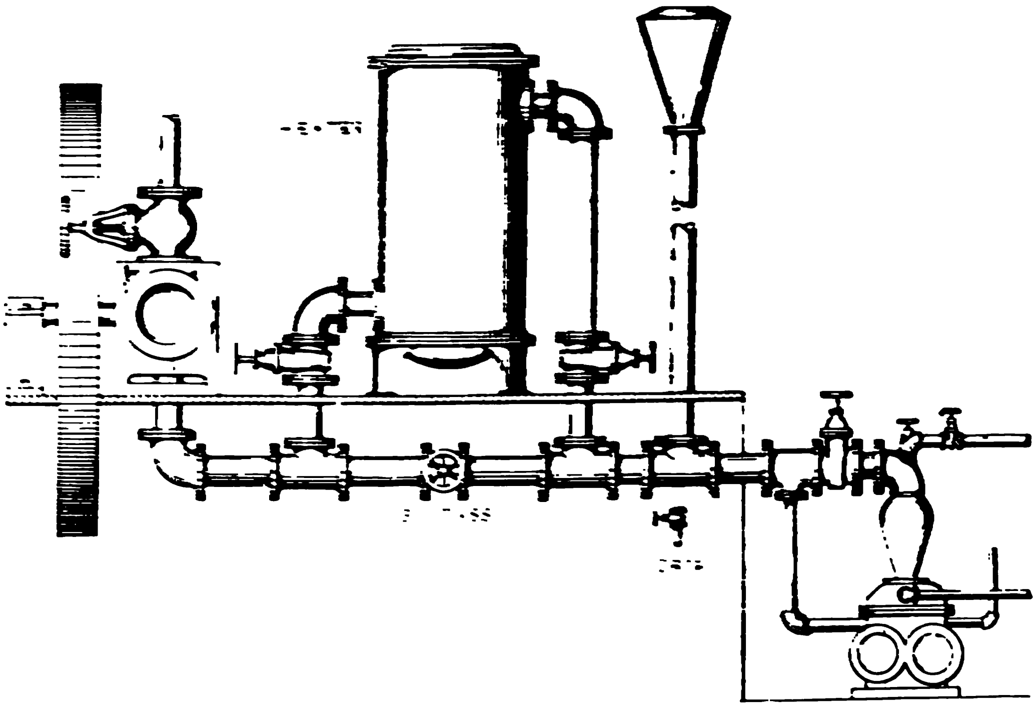
Air leaks alone are not responsible for the destruction of the vacuum, as too much, as well as too little, water will cause the vacuum to break. When too little water is admitted, all the steam is not condensed and the [illegible] [illegible] [illegible] the pressure in the condenser [illegible] [illegible] that the back pressure valve [illegible] and the engine exhaust into the atmosphere. [illegible] the air pump becomes [illegible] with [illegible] [illegible] [illegible] of the condenser is decreased and [illegible] [illegible] so that air will gradually accumulate and the vacuum becomes lower. The condenser [illegible] ordinary pump, should be [illegible] [illegible] and at the same time [illegible] [illegible] of the necessary quantity of water and to maintain the desired vacuum. It is evident, however, that if air enters the condenser must be operated at a higher speed, although the load on the engine and other conditions may remain the same. When it becomes necessary to gradually increase the speed of a condenser it is an indication that a leak exists at some point, either in the exhaust pipe, the [illegible] of the condenser, the valves or piston of the condenser itself. To prevent leaks as much as possible, it is advisable to renew the packing at short intervals. Packing can be used until it ceases to give when the gland is tightened.

While it is generally true that the higher the vacuum the better the results, there are times when better economy may be obtained by reducing the vacuum. For instance, when a light load is on the engine and there is but little resistance above that of the ordinary friction. The reason for this is that the engine uses the steam expansively, while the condenser does not, and the part of the steam used by the condenser could be used to better advantage in the engine cylinder.

When an engineer goes to a new plant, or a new condenser has been installed, the running position of the injection valve is of course not known to him. This is something that will have to be determined by re-[illegible] It will be safe, however, to begin with the valve about half open, gradually opening it wider until the desired vacuum has been obtained.

After one has had a little experience in operating a condenser he will be able to tell to a certain extent whether the condenser is operating properly or not. Before the load is thrown on the engine the condenser discharge pipe will be considerably cooler than the hand, but after the load has been thrown on the engine it will be a trifle warmer than the hand. When the water becomes so hot that the pipe burns the hand there is danger of losing the vacuum.

An auxiliary injection pipe should be connected to the city water supply or the discharge pipe of any cold water pump, in order that the main injection supply may be reinforced if desired. This is particularly important in the case of the jet condenser, which lifts its own water, for if the vacuum is lost the suction is lost also and without the aid of the auxiliary injection pipe, it can seldom regain the vacuum without allowing the engine exhaust to escape to the air until the condenser can be cooled.



[illegible] PIPE CONNECTIONS [illegible] CONDENSER CONNECTED TO HEATER AND ENGINE.

It is also particularly convenient if there is a sudden increase in the load and the discharge becomes too hot. In this case the temperature can be restored to normal by the use of the auxiliary injection water. Such an arrangement is usually provided with the condenser and it may enter the exhaust pipe anywhere that is convenient.

For those who are not familiar with the auxiliary injection it may be said that any engineer can make one by securing a piece of 2-inch pipe about 3 feet long which is perforated with small holes so as to make a spray head. This apparatus should be carefully watched while it is in operation, and shut off as soon as its purpose has been accomplished, because if it is allowed to run unnoticed there is a danger of flooding the condenser and working water back to the engine cylinder.

If it is desired to change an engine running noncondensing to condensing without stopping the engine, the air pump should be started first and the injection valve opened in the usual way. The valve in the exhaust pipe leading from the low pressure cylinder to the condenser will be closed or should be closed when the engine is running noncondensing. This valve should always be closed when the engine is not running condensing as the steam will be liable to injure the condenser valve.

When the condenser is working properly, the valve in the atmospheric exhaust pipe is partly closed and just at the moment when the vacuum begins to drop the back pressure valve should be closed, after which the valve in the condenser exhaust pipe should be opened wide. Care should be taken, however, in opening the valve in the exhaust pipe before the back pressure valve is closed, to stop as soon as the vacuum begins to fall or it will be lost entirely.

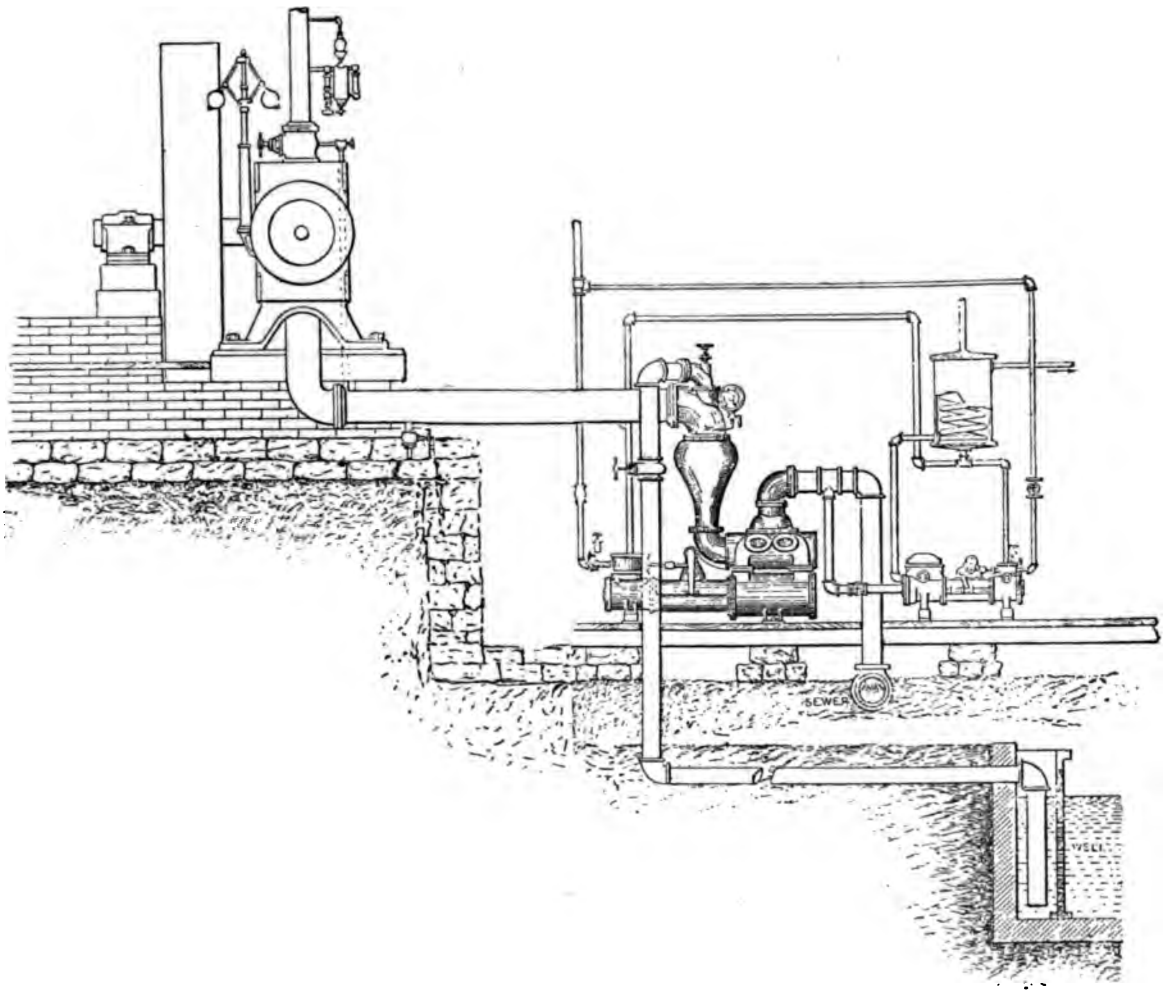


FIG. 6. ANOTHER METHOD OF CONNECTING A JET CONDENSER TO ENGINES, HEATER AND PUMP.

In changing from condensing to noncondensing it is only necessary to close the valve in the condenser exhaust pipe and stop the condenser, because as soon as the pressure in the exhaust pipe equals that of the atmosphere, the back pressure valve opens automatically. When stopping a condensing engine the engine should be stopped first and the condenser afterwards.

Condensers are not free from trouble any more than any other apparatus connected with the steam plant. The siphon condenser is probably the cheapest of any and doubtless gives the least trouble. One trouble is caused by small stones and leaves lodging in the condenser nozzle. Of course when this occurs the remedy is to remove the ell on top, and clean out the nozzle.

To eliminate this trouble and the annoyance and expense occasioned by the stoppage of the nozzle, strainers should be placed in the injection pipe to the condenser, in order to catch the leaves, sticks, fish, etc. Such a strainer is made which allows the removal of any obstruction and without interrupting the flow of water to the condenser without breaking the vacuum. In the device we have in mind there are two strainers so arranged that either strainer can be opened while the other is in operation, thus allowing the clogged strainer to be taken out and cleaned and placed ready for service again.

Not only is the condenser an important auxiliary of the reciprocating engine, but it is necessary in the steam turbine plant.

The saving due to vacuum and superheated steam has been determined by tests, in which it has been shown that the rate of increase in the last few inches of vacuum is of great importance. For instance, with 21 inches of vacuum, the gain is but 1 per cent per inch. At 26½ inches the gain is 3½ per cent and at 28 inches it is estimated to be 5½ per cent. In running condensing with the turbine, it is important to maintain a high vacuum, which can only be brought about by the exclusion of entrained air, which may find its way into the condensing system in different ways. It may come in through the feed water, the steam, through leaks in the piping or through packing glands improperly sealed. A very small opening will have a remarkable effect in lowering the vacuum unless the air is removed before reaching the condenser. This is usually accomplished by a single or double stage dry air pump. A small steam ejector which removes entrained air from the condenser casing, and discharges into a small auxiliary condenser, has been successfully used, and by this means has raised the vacuum 2 inches, or about 4½ per cent net gain.

On account of the trouble from air entering through the feedwater the surface condenser has found particular favor in turbine work. The surface condenser also enables the condensed steam to be returned to the boilers, which is a saving of water and cuts off the cost of purifying it and reduces to a great extent the cost of maintenance in the way of cleaning and repairs to the boiler equipment.

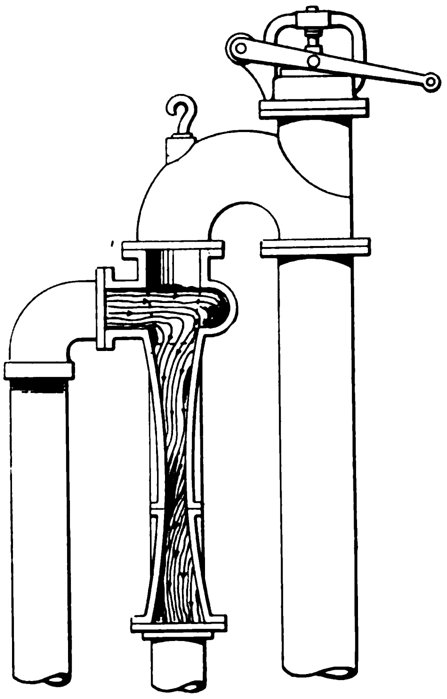


FIG. 7. SIPHON CONDENSER.

In the most modern plants the practice is to install an independent condensing system. It is only recently that this method of condenser operation has been adopted. Formerly every condensing engine operated its own air pump. It has been found by experience that the independent condensing plant is the cheaper to operate, although the old method has its advantages, and is free from some of the defects of the independent system.

Of late years, due to the introduction of high steam pressure, the condenser has been somewhat neglected, because it is claimed by many that condensing is of less importance than formerly, although this kind of argument is not what would be considered good engineering. If an engineer can make his condenser give a result of from 25 to 26 inches, it is his business to do so. If it does not pay to operate the condenser it is better to discard it entirely, but while it is in operation all leakage of air should be prevented and the plant made to run efficiently.

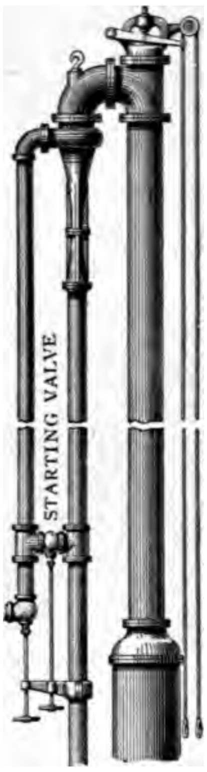


FIG. 8. SIPHON CONDENSER AND STARTING VALVE.

If, in an independent condensing plant, where the engineer is striving to obtain as high a vacuum as possible, there is an air leakage, the pump must run at a maximum speed, in order to maintain the vacuum and in this way a large amount of steam is wasted by the steam end of the air pump. By speeding up the air pump the engineer is able to maintain the vacuum, and those who are not acquainted with the plant have no knowledge of the waste that has taken place, but have the impression that the system is operating in a satisfactory and economical manner. In the system where the air pump is dependent upon the engine, it cannot be speeded up and the defects of the piping are made manifest through the low vacuum as shown by the vacuum gage.

Another source of air leakage is probably caused by the modern automatic atmospheric relief valve which is not, in the greater number of plants, at least, arranged with a water seal which would effectually prevent the leakage of air.

In testing a vacuum system it is not a bad idea to watch the system to see how long the vacuum will be maintained after the engine has been stopped. If it falls rapidly it may be taken as an indication that there is a serious leak somewhere which should be looked after immediately.

Even in the most modern and up-to-date condensing systems, trouble often occurs, notwithstanding the abundance of condensing water and the apparently tight connections. An instance of this sort occurred in a large power plant in New York in which the pistons were over 88 inches in diameter with a speed of 750 feet per minute. This meant that with the loss of every inch of vacuum, it cost over 275 horsepower. Here it is evident that it was important to realize the last inch of vacuum possible, and while the loss is not so much in smaller engines, yet the same principle holds good and goes to show that every inch of vacuum gained is a step toward the economic operation of the plant.

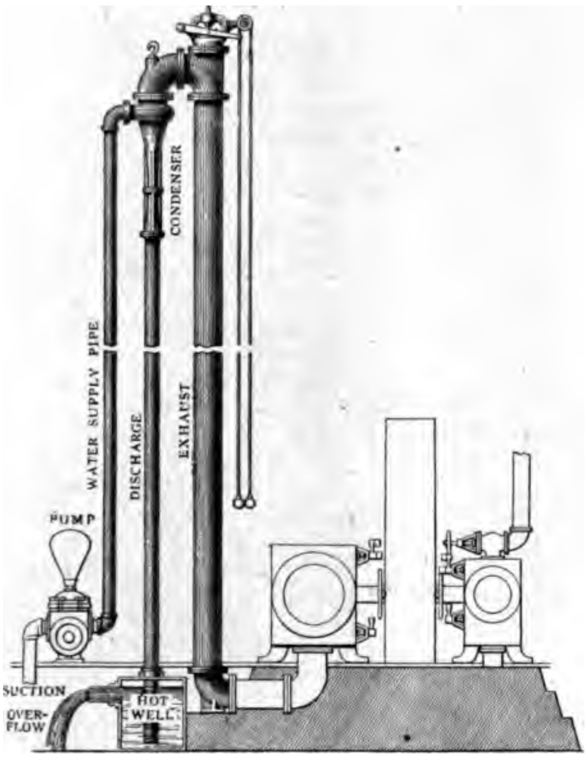


FIG. 9. SIPHON CONDENSER CONNECTED TO ENGINE.

The electric street cars of San Francisco are soon to be propelled by power generated by the largest gas engine plant in the world. An order has been placed for the new gas engines, which will require several months to build.

There will be at the start three 4,000 kilowatt capacity, 3-phase, 13,200-volt, 25-cycle, 88 revolutions per minute, revolving field alternating current generators, to be driven by 5,400 horsepower gas engines. These generators are the largest in capacity in the world driven by gas engines.

THE GAS ENGINE.

Engineers do not need to be told that the gas engine has passed the initial stage, and developed into an important factor as a prime mover in the engineering field. The day is rapidly approaching when the gas engine will supplant the steam engine for many purposes. In fact, it already has. It will grow more and more into favor, when it becomes a matter of general knowledge that its use, even in small sizes, results in an economy equal if not greater to that often attained by the triple or quadruple expansion engine.

The question of fuel economy is of the utmost importance to the power producer, and a gas engine is used in many instances, because the saving in fuel will amount to the entire cost of the plant within a few years.

The gas engine is now quite well understood by progressive engineers and its action will not be described in this article. While it is simple in operation, no one should get the impression that the principle on which it works should be neglected. The man who attempts to operate such an engine without sufficiently understanding it, will find that the results are more or less unsatisfactory.

The larger number of our engineers have, during the last 25 or 30 years, devoted their energies mainly to the perfecting of the steam engine. In spite of the advancement in the use of higher pressures, multiple expansions, and superheated steam, they have failed to make the steam engine compete in economy with the gas engine, although its greatest progress has been made within the last few years.

Both steam and gas engines derive their power from the combustion of fuel. With the steam engine the fire is under the boiler, but in the gas engine it is inside of the engine cylinder. It is evident that a gas engine plant, without its boiler and auxiliaries, is in every way cheaper and simpler, and has a greater advantage, because it can do more work per pound of fuel, than can the steam engine with its attachment of boilers and pipes. In the steam engine a small unit is not as economical as a large one. This may also be true of the gas engine, but small gas engines have been found to be almost as efficient as the larger ones. The small steam engine necessarily requires a steam boiler of some type which, regardless of size, requires watching while in operation, but the gas engine will run for hours with practically no attention.

There are several points of importance which interest the buyer of a gas engine. First, the capacity of the engine in brake horsepower. Second, its performance in British thermal units per hour, necessary to maintain each brake horsepower. Third, the adaptability of the engine to the service for which it is intended. The cost of the engine and the workmanship in its manufacture should also receive careful consideration. It should be of the best workmanship and material that can be obtained for the money. The guarantee which goes with the engine involves many problems all of which should be specified.

Power depends on mean effective pressure and piston speed. Mean effective pressure depends primarily upon the kind of gas and on the treatment of the gas in the engine. Piston speed in a gas engine depends upon nearly the same conditions as in the steam engine. The kind of fuel and its treatment determine the economy. The regulation depends on the method of governing the combination of cylinders, or the way in which the gas is treated to produce a uniform turning effort and whether it permits of a quick change to meet fluctuating loads.

The capacity of the gas engine is generally guaranteed in terms of brake horsepower which is determined by a test. The brake horsepower depends upon the indicated horsepower and the energy lost in the engine. These losses may be due to friction, gas losses by leakage, the passage of gas through restricted openings in the suction, exhaust transfer passages or otherwise. With the four cycle engines, the most important losses are those of mechanical friction and fluid losses and leaks. With the two cycle engines there is usually a greater fluid loss than with the four cycle engines because of the necessity of quick transfer of the charges from the suction chamber or precompression pump to the motor cylinder when the crankpin passes through a small arc about the dead center.

Increase in size and in compression pressures are the most marked features in the present development of the gas engine. Compression is one of the chief elements conducive to high efficiency, but there is, however, a limit to this, as the compression of the charge necessarily heats it. If the compression were carried to a sufficiently high pressure it would cause the firing of the charge. This is something that is carefully avoided in the ordinary gas engine, although in some types, ignition is accomplished altogether by this means. In the ordinary gas engine, however, firing is usually accomplished by an electric spark as it can be completely controlled.

Several methods for governing gas engines have been devised, but two only have been used to any great extent. In one method this is accomplished by causing the engine to miss one or more working strokes. This method, however, requires a heavy flywheel, which is a disadvantage, and even then there is considerable variation in speed. On the other hand it has the advantage of high efficiency at all loads, as the quality of the mixture and the compression previous to ignition, are the same whether the load be heavy or light. The irregular speed under such governing is such as to render it unsuitable for many kinds of work, especially that of driving alternators in parallel. The method usually employed, especially for large sizes and for electrical work is that of varying the amount of mixture administered to the cylinder, at the same time keeping its quality constant as much as is possible. A heavily loaded engine will require its cylinder to be practically full of explosive mixture, but with this method the mixture is suited to the compression which takes place. When the engine is working under a light load the quality of the mixture can be maintained by allowing it to mix with the air just sufficiently to properly ignite under the compression which takes place.

In economy of fuel the gas engine has no rival. The present limit of the steam engine is 10 pounds of water per indicated horsepower or 11 pounds per brake horsepower. This evaporation is 10 pounds of water per pound of coal containing 14,000 British thermal units. A brake horsepower is equivalent to 15,400 British thermal units of 1.1 pounds of coal. With the gas engine at full load a brake horsepower is obtained with 10.5 to 11 feet of gas which equals from 900 to 1,000 British thermal units per cubic foot, calorific value. This is equivalent to 11,000 British thermal units per brake horsepower.

A gas engine plant requires as much skill in some instances to operate as a steam plant does. With a light load the gas engine shows a greater efficiency than a steam engine of corresponding size, the cost of operation and maintainance is low, while in equipment, it is exceedingly simple. Very few auxiliaries are required; it is quick to get started, the waste heat in the jacket water is suitable for heating buildings, and in case the plant requires an extension no alterations are required.

In gas engine plants the danger of explosion from high pressures in boilers, piping, etc., is absent and there is no danger from an explosion of gas outside of the engine cylinder, as a mixture of proper proportions is required to bring it about. As soon as a gas engine is shut down, all heat loss is stopped. This is another source of economy.

The cost of the gas engine is somewhat greater than that of the steam engine. The steam engine has a certain amount of overload capacity, that is, it is capable of operating under a load greater than its official rating, but at a somewhat impaired efficiency. The gas engine has, properly speaking, no overload capacity, as its performance improves up to the point where it can carry no more load, after which any further loading causes the engine to slow down. In purchasing a gas engine it is necessary therefore to provide for a rated capacity approximately equal to the overload which may have to be carried. For this reason a comparison of prices on the basis of the cost per horsepower is not always correct.

The use of large engines for driving direct coupled dynamos for various purposes is coming rapidly into favor. In some instances the engine runs day and night at its full output which is a severe strain on every part. Electric practice requires steadiness in running and accurate governing. This has been accomplished with large engines of the four stroke type using four cylinders in suitable combination, and by using the impulse automatically, by means of the governor, almost perfect regulation has been obtained.

To successfully operate gas engines, it is necessary to keep them clean. The igniter which is an important part of the internal combustion engine requires care and if it is of the wide-spark type, the points will wear longer if the polarity of the current is changed each day. This can easily be accomplished by means of a double-throw switch placed in the circuit. This switch may also be used as the main switch. The governor also requires special attention. It is just as essential to give the gas engine careful attention as it is the steam engine and most of its failures are due to mismanagement and neglect.

Every gas engine manufacturer provides rules by which his gas engine may be successfully operated, so that nothing need be said on this score.

According to the standard of the British admiralty the knot is the length of one minute of longitude at the equator, or 6,086 feet, 1.1527 statute miles, or 1,855 metres. The mean length of latitude, sometimes reckoned as a knot, is 6,076 feet, 1.151 statute miles, or 1,852 metres. A marine league is three of these sea miles.

BOOKKEEPING FOR ENGINEERS.

Steam engineering has advanced to a point where economy in the operation of the plant is a necessity. To obtain the highest economy, the engineer must keep an accurate record of the operation of all the machinery in his care, as well as an account of all the supplies received. Complicated accounts are not necessary and the simpler the system the less time required to keep it up. About all that is necessary is a blank form for the daily report and another for a monthly summarizing report.

The daily report can be printed on one blank of convenient form by using both sides. The same may be done with the monthly report. In small plants a card or sheet printed on one side only is more satisfactory. It is a good idea to have the daily and monthly report sheets printed upon different colored paper in order to distinguish one from the other.

temperature of the feedwater, which may be obtained from a thermometer placed in the feedwater pipe leading to the boilers. This reading should be taken during each hour of operation and the result recorded in the proper column. For example, in the column "temperature of feedwater," no reading was made from 1 a. m. until 6 a. m. when the boilers were fired up. The temperature of the feedwater was then 150 degrees, due to the exhaust from the pump and a small bleeder pipe running to the heater to supply live steam. At 7 a. m. when the engines were started, the temperature advanced to 203 degrees, and ranged from 200 to 208 degrees for the remainder of the day.

The steam pressure should also be read hourly, because of variation in the pressure which occurs in every day practice. The table, however, shows a far more uniform steam pressure than is found in the average steam plant.

No. 1. Daily Report of Operation of......Plant at .... June 20, 1905

	Boilers				Draft ins. water	Temp. of feed.	Steam press	Heat'g system		Direct steam pressure.	Eng. Service			Electrical Service					Remarks
														Constant Current Generators		Constant Potential Generators,			
	1	2	3	4				Return Vacuum.	Direct live steam		1	2	3	:	2	3	4	5	
1	B	B	B	W	½		80	24	3		S	S	W		25				
2															25				
3															25				
4															25				
5															30				
6	F	F	F	W		150	100	25		8					40				
7						203	100				W	W			50	30	31	33	
8						204	102								45	31	31	33	
9						204	101								20	32	33	31	
10				F		205	102								12	30	33	30	
11						205	101								12	32	30	33	
12						204	100								12	28	30	33	
p. m.																			
1					½	208	103	23							12	30	31	32	
2						208	102								11	27	33	31	
3						207	101			8					12	32	30	29	
4						206	100			0					12	20	24	36	
5						205	100								40				
6	B	B	B			200	90					S	S	32	52				
7														30					
8														25					
9														25					
10														25					
11														25					
12														25					
Total Hours														187	460	292	306	321	

Boiler Service. W—washed out. B—banked. R—repairs. C—cold. F—fired.

Engine and Generator Service W—working. S—stopped. R—repairs.

If the plant is operated 24 hours each day the blanks should be divided into two watches of 12 hours each, or if there are three shifts, into watches of 8 hours each. The blanks should have a space for the record of each boiler, which should be designated by a number, as boiler No. 1, No. 2, etc. When this has been done the record of each boiler can be kept by using the letters at the bottom of the sheet, No. 1, designated "Boiler Service." *W* means, washed out, *B*, banked, etc. For instance, boilers 1, 2 and 3 were banked from 1 a. m. until 6 a. m. They were then fired up and were in operation until 6 p. m., when they were banked for the night. No. 4 boiler, which was being washed out, was fired up at 10 a. m. and operated the rest of the night.

The next heading is that of draft which is very important. This reading is obtained by noting at the beginning of each watch, the difference of level in inches, of the water in the draft gage. Next is the

Manufacturing plants equipped with a heating system should keep a record of its performance. This can be done by dividing the head into divisions, "Return" and "Direct," while under the heading "Return" are subheads, "Vacuum" and "Live Steam." If the system is operated in conjunction with a vacuum pump, the vacuum should be read every hour. The table shows a vacuum of 24 inches at 1 a. m., 25 inches at 6 a. m. and 23 inches at 1 p. m. The column, "Live steam" refers to steam furnished for heating either exhaust or live steam, the condensation of which is returned to the boilers. Two pounds pressure is shown to have been on the heating system all day. The direct steam pressure referred to in the next column is steam used in the heating system at a higher pressure, the returns of which do not go to the boilers, and shows a pressure of 8 pounds between 6 a. m. and 3 p. m.

The engine record shows that engine No. 3 was in operation from 1 a. m. until 6 p. m., while engines Nos. 1 and 2 were started at 7 a. m. and operated until 6 p. m., when engine No. 2 was shut down. No. 1 operated for the remainder of the night. The next columns are for the electrical record. The first two columns are for the constant current machines which in this case are of the alternating type, and the other division for the constant potential machines. At 1 a. m. the alternator had generated 25 kilowatt hours, the load remaining constant until 5 a. m. when it was increased. At 6 o'clock the load was heavier, while at 7 a. m. the full lighting load of 50 kilowatt hours was on for the day. This gradually decreased during the day, increasing again at nightfall. At 6 p. m. the load was 52 amperes. When the men in the factory went home the load decreased to 32 amperes. The load was then shifted to the other machine which was operated until the next morning.

The last three columns are for the record of the generator operating the motors. The load comes on at 7 a. m. and remains nearly constant all day having only the regular variation in load that all motor circuits have. At night the load is off, as the motors are only used during working hours between 7 a. m. and 5 p. m. Readings should be taken hourly from the ammeter. The result obtained from multiplying these readings by the potential or voltage of the machine at that time will give with reasonable accuracy the watts produced during that hour, or the watt-hours divided by 1,000 gives the kilowatt hours. If each machine is supplied with a recording watt meter on each dynamo circuit, the readings may be taken every day for the daily output instead of hourly. The total results show that No. 2 machine generated 460 kilowatt hours. No. 1 generated 187 kilowatt hours from 6 p. m. to 12 p. m. The total output for the day motor load is, machine No. 3, 292 kilowatts, No. 4, 306, and No. 5, 321 kilowatts.

No. 2. Coal Report.

From	To	Coal used lbs.	Water used.	Pounds water per lb. coal.	Kilowatt hour coal.	Kilowatt hours water.
1 a. m. m. m.	1 a. m. m. m.	6,616.5	60,865	8.1	4,5	39.6

For 24 hours 6,616.5; 60,865.
Oil, Pints, Cylinder, 6; Grease, ...lbs.
" " Engine, 7; Waste, ...lbs.

The reverse side of this sheet can be arranged for another report or a separate blank can be used. The form used, depends to a great extent, upon the size and nature of the plant. It should show a general summary of the day's records of the electric power in kilowatt hours, arc lights, incandescent lights, and storage batteries, if any. The record of the coal, etc., should also be kept, conveniently arranged as shown on record blank No. 2. This blank shows that from 1 a. m. to 1 a. m., 24 hours, the coal used was 6,916.5 pounds, the water used 60,865 pounds. The pounds of water per pound of coal was 8.1; pounds of coal per kilowatt hour was 4.5, and the water per kilowatt hour was 39.6 pounds. Space should be provided for a record of the oils, grease, waste and other supplies used.

A record of the arc and incandescent light system should be kept, showing the time the lamps are started in and cut out, also all other data that will admit of a thorough understanding of the operation of the system. This will also apply to the incandescent system. Under this last head should be recorded the number of lamps given out, the date when they were given out, also the date of return. This will enable one to find out the exact life of each lamp and the engineer can tell whether one lot of lamps is giving as good satisfaction as another.

No. 3. Engine Room Record.

Date 1905	Hours	Dynamo		Heat'g System		Lbs. Coal	Oil	
	Engine	Hours	Ampe's	Live	Exh'st		Cylinder	Engine
June 20	10	5	341	a. to p. m. " m. 5 " 7	a. to p. m. " m. 7 " 6	18,320	2 qts.	4 qts.

The monthly report is nearly a duplicate of the daily report with the exception that the report for the month is condensed, and can be read at a glance. The report blanks may be designed practically the same as the daily report blanks, with additional lines for other data that may be desired. In order to have a complete record of these reports for his own use, the engineer can either take a duplicate copy of his monthly report or retain the daily reports sending only the monthly ones to the office.

It may seem to many that this work is irksome and a waste of time each day. However, it really requires very little time to keep up the record, and its value cannot be appreciated until the engineer uses it for a while. He will never care to return to the old plan which is merely guess work. These reports keep the engineer in close touch with his plant, making him watchful and observing, and thereby aiding him in detecting leaks before they are found out by another person. These report blanks by altering slightly may be used in almost any kind of a plant.

No. 4. Fire Room Log.

Time	Pressure		Temperature		Remarks
	Steam Pressure	Draft Gage	Feedwater Supply	Feedwater Entering Boiler	
7 a. m.					
8 "					
9 "					
10 "					
11 "					
12 m.					
1 p. m.					
2 "					
3 "					
4 "					
5 "					
6 "					

A more simple report sheet is shown by No. 3 blank. On this blank the date and hours the engine is in operation, the hours the dynamo is running, together with the number of amperes during the day are recorded. No. 3 blank shows the live steam to have been on from 5 a. m. to 7 a. m.' when the exhaust steam was turned into the heating system and continued until 6 p. m. The coal burned during the day was 18,320 pounds and the amount of oil used was 2 quarts of cylinder and 4 quarts of engine oil. This report will meet the requirements of the engineer who is operating a small plant of one boiler and engine. A much more satisfactory data sheet of the operation of the plant can be obtained if the engineer has an indicator to record the output of the engine for each day.

A fire room log is shown in report blank No. 4. This gives the hours, the steam pressure, draft in inches in the stack and the temperature of the feedwater before and after passing through the heater. Underneath this record comes the record of the coal used, in the following manner:

Daily Report.

Coal for starting fires .... lbs.
Coal used for daily run .... lbs.
Coal used for banking .... lbs.
Coal used, total .... lbs.
Ashes .... lbs.

Water metered at 7 a. m.

Yesterday .... cu. ft. or gals.
Today .... cu. ft. or gals.
Difference .... cu. ft. or gals.
Cylinder oil .... pts.
Waste .... lbs.
Note ....
Date ....

A monthly summary of the daily log can be prepared in the following manner:

Monthly Summary.

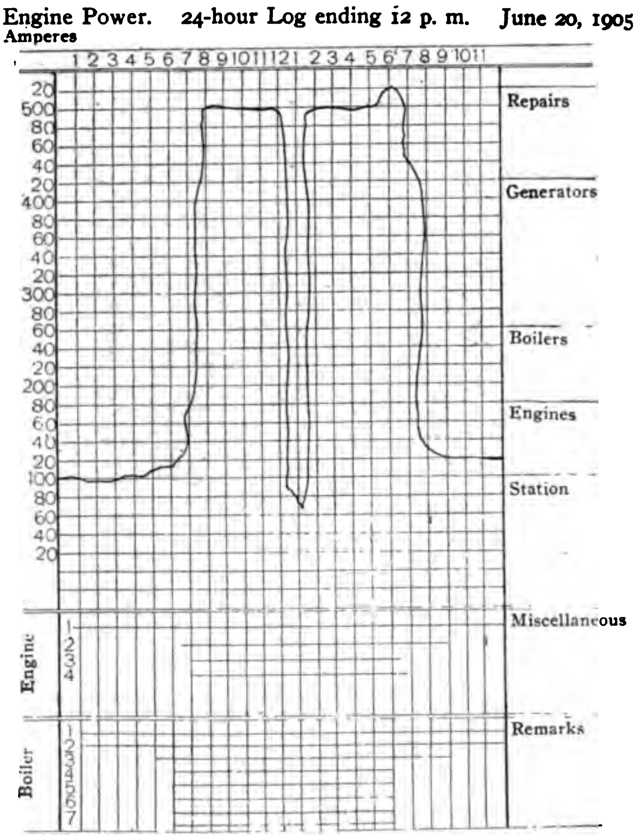
Water used, gal. or cu. ft. ....
Water used in pounds ....
Weight of coal ....
Cost of coal $...
Average steam pressure ....
Average draft ....
Average temperature of cold water ....
Average temperature of feedwater ....
Cost of waste ....
Cost of cylinder oil ....
Wages, regular ....
Wages, extra ....
Cost of coal to evaporate 1,000 pounds of water into steam for the month...........................

Another kind of power plant log is shown in Fig. 5. This plan does away with very much figuring as to the output of the engines and dynamos. It is only necessary for the engineer to record the reading of the ammeter and draw in the load line at the end of the day. This log perhaps is better adapted to street car service or illuminating power plants, than manufacturing plants. It may, however, be readily used in a plant furnishing electric power to the building It gives not only the load in amperes, but also the hours each engine and boiler is in operation during the 24. By referring to the log it is seen that the load from 12 midnight to 4:35 p. m. is practically constant, then gradually increasing until 7 a. m. At this time the motor load of the factory is thrown on, causing the amperes to run up. When the operatives start work the ampere load suddenly rises to the peak of the load, which the engines have to carry during working hours. There is a decline between the hours of 12:30 noon and 1:30 p. m., but the load for the afternoon rises again at 1:30 o'clock remaining practically steady until late in the afternoon, when a small lighting load is added. At 6 p. m., the load begins to gradually decrease taking a sudden drop at 7:45 p. m. when the motor load is removed entirely. The load for the night is thus reduced to 120 amperes, which remains on until midnight when it drops down to that at the beginning of the log. This proves the load from 8:30 to 12 midnight to have been the same.

The log shows the engines were in service for different periods of time. No. 1 engine was in operation the entire 24 hours. No. 2 was started at 6:30 a. m. and continued in use until 9 p. m. when it was shut down. Nos. 3 and 4 were started at 7 a. m. and operated until 6:30 and 7 p. m. respectively. The boilers were operated as follows: Nos. 1 and 2 were fired the entire 24 hours, while No. 3 was fired at 5 a. m. and operated until 9 a. m. Nos. 4, 5, 6, and 7 boilers were fired up at 6 a. m. and operated until 6 p. m. when they were cut out and banked for the night. All of this is indicated on the log by drawing a dark line from the time the engine or boiler began operation until it was cut out of commission. At the right a space is provided for the record of engine repair, generators, boilers, pumps, stokers and miscellaneous repairs, while below a space is left for the total report of the day. This graphic representation of the daily load of the plant and the number of engines and boilers in commission during any time of the day, gives the engineer or manager of the plant a very complete record of each day's operation.

No. 5. Power Log.

Engine Power. 24-hour Log ending 12 p. m. June 20, 1905.

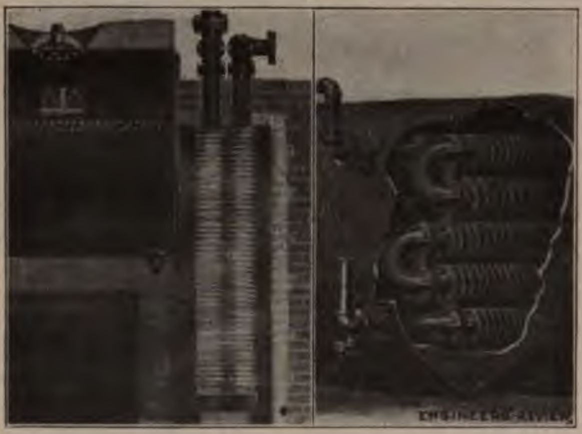


SUPERHEATED STEAM.

Nearly all engineers know superheated steam has a higher temperature than that normal to its pressure, and that it is steam dried by heat applied to it after it has left the boiler; that is, steam is said to be superheated when at any given boiler pressure it has a higher temperature than the water from which it was evaporated. In fact, superheated steam does not contain moisture, as the moisture takes the extra heat from the steam, and is itself evaporated.

It is a well understood fact that the temperature of saturated steam cannot be raised without an increase in pressure, while on the other hand, if superheated steam is allowed to expand, the temperature can be raised without increasing the pressure. This expansion is taken care of by steam being used by the engine, or by its escape through the safety valve.

Superheated steam may be produced in three ways: One is to place the superheater in the flue where it will be exposed to the hot gases after they leave the boiler, which results in a slight gain in boiler efficiency, as the heat put into the steam would otherwise be wasted; the gain being about 2½ per cent in a boiler working at ordinary rating. This amount of superheat varies considerably, due to the position of the superheater in the flue, because the temperature of the gases is but very little above the temperature of the saturated steam when the boiler is being worked at ordinary rating; while on the other hand, the difference of temperature between the gases and the steam increases much faster than the amount of steam to be superheated when the boiler is forced, so that the amount of superheat gained is very much greater.



FIGS. 1 AND 2. SUPERHEATER AS APPLIED TO RETURN TUBULAR AND MARINE BOILERS.

As both superheater and a certain type of feedwater heater, known as an economizer, are placed in the flue between the boiler and the chimney, a comparison will not be out of place. While the superheater in the flues saves a small per cent of heat, an economizer will save more heat at less expense.

The difference in temperature between the gases and the steam is only about 200 degrees with a superheater, while the difference in temperature between the gases and water would be about 400 degrees with an economizer. A given area of heating surface in an economizer would increase the boiler efficiency five times as much as the same area of superheating surface. This applies to superheaters that are located in the flue.

Another way of arranging the superheater is to install it in a separate furnace; this, of course, requires an additional consumption of coal, but additional heat is put into the steam, and it is theoretically possible to make a superheating furnace which will be as efficient as a boiler; when such conditions exist there will be no loss in the total boiler efficiency. This application of the superheater is best adapted for use in plants where the steam is conducted to buildings located at a considerable distance from the central boiler plant. A superheater under such conditions may, by means of a small fire of any combustible, add enough heat to the steam not only to evaporate all the moisture due to the loss of heat in transit, but to raise the temperature to such a degree as to superheat the steam.

Several practical difficulties prevent the efficiency of a furnace for separate superheating, one of which is that the superheater furnace would be of small size compared to that of the boiler, and the total efficiency would probably be diminished.

The third application of the superheater is in the path of the gases after they have passed over a portion of the heating surface, but before they leave it finally. In some types of water tube boilers the superheater is placed between the tubes and the drum, between the first and second baffle walls. With the superheater thus arranged, the gases give up the same amount of heat to the first section of heating surface as they would if the superheater was not present; but in the next pass the gases give up a portion of their heat to the superheater. The giving up of this heat goes to increase the total efficiency, but it also reduces the temperature so that the heat given up to the remaining heating surfaces is less than it would have been without the superheater. The result is the same, however, as if additional heating surface had been added to the boiler.

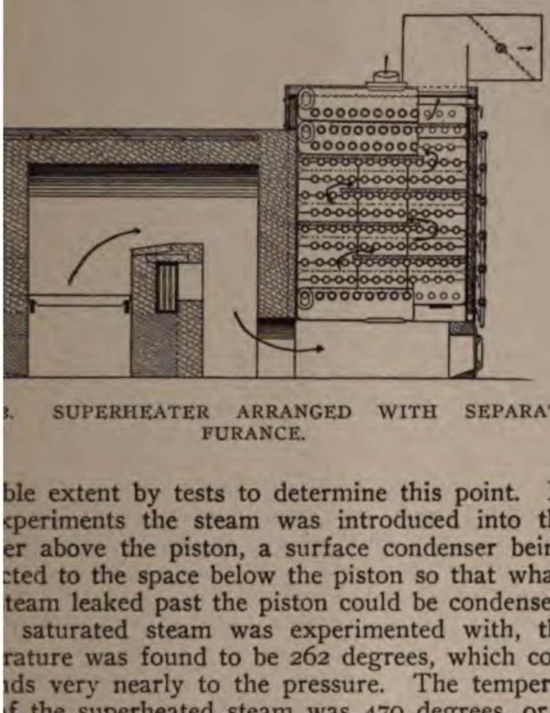
In independently fired boilers of the marine type the superheater may be placed at the back of the boiler where the gases turn to enter the tubes. In the ordinary return tubular boiler it may be placed in the chamber at the back end at the entrance to the tubes where the temperature of the gases is very high and the heating surfaces may be distributed with considerable efficiency.

Superheated steam is used because of its increased efficiency, although the percentage of economy obtained is often difficult to prove because of the expense of the careful experiments that must be made both before and after the change is effected.

In order to be efficient, superheated steam must not only be produced economically, but must also be properly utilized; that is, when very hot steam is used, the steam engine must be specially arranged to receive it, as the valves, stuffingboxes and piston rings require particular attention to prevent undue wear or trouble when using such hot gases. The question of lubrication has but little trouble attached to it now, if the best of mineral oil is used.

The argument first used in urging engineers to adopt superheated steam was to avoid the loss due to initial condensation in the cylinder, and that the saving would be enough to justify the use of superheated

Since that time it has been discovered that are other advantages connected with its use. A eight of superheated steam is required to fill the er at any given cutoff than dry steam at the pressure, and the extra heat to secure this volume than would be required to produce saturated to fill the same space. There are also reasons to believe that the leakage of heated steam by piston and valves is less than f saturated steam. Although this may seem sonable, it is nevertheless borne out to a con- ble extent by tests to determine this point. In xperiments the steam was introduced into the er above the piston, a surface condenser being cted to the space below the piston so that what- team leaked past the piston could be condensed. saturated steam was experimented with, the rature was found to be 262 degrees, which cor- ds very nearly to the pressure. The tempera- f the superheated steam was 479 degrees, or a ieat of 217 degrees. With the saturated steam -ounce bottle was filled with condensed steam in nutes and 53 seconds, while with superheated 8 minutes and 4 seconds were required, thus ng a reduction of condensation, and leakage by e of superheated steam of about 21 per cent.



SUPERHEATER ARRANGED WITH SEPARATE FURANCE.

behavior of the superheated steam is similar t of gases; that is, it is a very bad conductor of and has the peculiarity of being able to lose a n amount of heat without becoming saturated or The thermal capacity of steam is only 0.48, ore very little heat is required to superheat l as it loses the heat as quickly as it acquires it, passage conveying superheated steam must be overed with nonconducting material.

economy effected by using superheated steam in es is very remarkable, and in many cases where perheat has been only a few degrees, a saving am and coal has always been the result.

introduction of superheated steam into engines ices largely the expansion of the heated part. his reason, valves containing many ribs or of nt thickness, when in sections, such as plain alves or Corliss valves of the usual construction t suitable for high temperature. A Corliss valve and about 480 degrees F. With slide valves, the r they are, the higher temperature they will while large slide valves will hardly stand even slightly heated steam if no provision is made for forced lubrication of the face. Piston valves have proved to be suitable for the highest temperature owing to their uniform distribution of metal. Long valves are objectionable when cast in one piece, as they become scored whether they are cooled from the inside or not; they should therefore be made as short as possible.

Valves fitted with rings and springs are not to be recommended, as the steam comes behind the rings and increases the pressure, causing friction, and therefore increased oil consumption. Piston valves should be made as small in diameter as possible, as it is impossible to rely upon them remaining tight. Small valves may be used with good results as superheated steam travels at a speed 30 or 40 per cent greater than saturated steam.

An engine that has been constructed to operate with superheated steam is as safe with it as an ordinary engine working with saturated steam.

Highly superheated steam has other advantages besides economy, which are important. By its use the steam consumption is nearly independent of the size of the engine, a small engine having about the same steam consumption as a large one. For instance, an 80-horsepower compound condensing engine will use 10.45 pounds of steam at a pressure of 160 pounds, and a 1,000-horsepower engine uses 9 pounds of steam per indicated horsepower per hour.

Highly superheated steam does not mean that a high boiler pressure is required, as no advantage is gained with steam exceeding this pressure, and as the amount of heat transmitted from the steam to the cylinder and from the walls of the cylinder to the steam is much lower with superheated steam than with saturated steam, the whole range of temperature from boiler pressure to vacuum can take place in one or two cylinders.

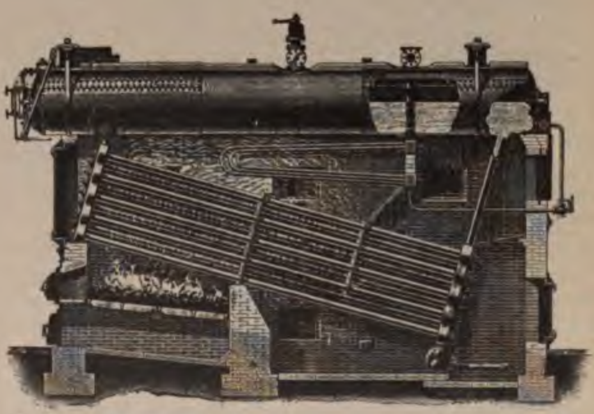


FIG. 4. WATER TUBE BOILER ARRANGED WITH SUPERHEATER.

The economy obtained from engines working with superheated steam is derived from the large volume of steam and the removal of initial condensation. The steam consumption of single cylinder condensing engines using saturated steam at a pressure of 90 to 100 pounds per square inch, will be 19 to 25 pounds of steam per indicated horsepower per hour. As the difference between the admission and the exhaust steam is very great, there is much waste by initial con-

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POWER PLANT MANAGEMENT NUMBER.

It will be noticed that the articles in this number are on subjects that pertain directly to the design, installation and management of the power plant. It is not possible, in one issue, to go into the details connected with each subject so we have touched upon the main points only. These subjects are all of vital interest to engineers and if we have succeeded in producing a number of value to our readers, wholly or in part, we will not feel that we have failed. At any rate we have made the effort and you are free to comment on or criticise any point on which we do not agree.

(Concluded from page 47.)

densation, therefore this type of engine especially favors the use of superheated steam. With the same engine using superheated steam, the consumption has been lowered to from 13½ to 15 pounds per indicated horsepower. Noncondensing single cylinder engines decrease the consumption to from 15 to 18 pounds per indicated horsepower, which is about the same consumption as an average compound condensing engine with saturated steam. The compound non-condensing gives a consumption of from 14 to 16 pounds of steam per indicated horse power hour. The compound condensing engine is the most economical.

Superheated steam engines use on an average of 30 to 40 per cent less steam than saturated steam engines of the same type; therefore boilers can be made 30 per cent smaller, and the difference in price will nearly cover the cost of the superheater. For the same steam consumption, the superheated steam engine is cheaper, as it may be worked at a lower boiler pressure, and instead of a compound engine with saturated steam, a single cylinder engine with superheated steam may be used giving the same or better results than the former.

The economy to be obtained by the use of superheated steam with reciprocating engines has been so thoroughly demonstrated that the only question at the present time is how to best provide for its production and use. We have stated that with superheated steam the condensation in the cylinder is reduced, the reason being that the incoming steam strikes the cold walls of the cylinder which have just been in contact with the low temperature of the exhaust steam. When superheated steam is used this condensation is reduced, because its temperature is so high that the temperature has fallen at the end of the stroke to that of saturated steam, consequently the steam is released from the cylinder at about the temperature at which it begins to condense.

Practically, the only question to be settled is the degree of superheat, which depends largely upon local circumstances and the construction of the engine.

For ordinary conditions, it is not best to use steam superheated more than 135 degrees at a 150 pound gage pressure. This corresponds to a temperature of 500 degrees. Although some benefits may be derived from the use of a much higher degree of superheat, such a condition would necessitate specially constructed steam valves and pistons, which would cause a greater outlay in expense than the slight gain in economy. Partial benefits from superheated steam can be derived by the use of several devices. For instance, the high pressure cylinder is sometimes jacketed, through which the superheated steam passes on its way to the throttle, and in this way, initial condensation is largely prevented, but because of the radiation from the outside of the jacket, little more than dry steam is furnished to the engine, and so some of the benefit is lost, but the benefit of using superheated steam in this way is marked.

Another device is to arrange reheater tubes between the cylinders when using highly superheated steam which being at a much higher temperature and pressure than the high pressure exhaust superheats the supply to the low pressure cylinder. Tests have shown that with this method, there is practically no condensation in the low pressure cylinder. Sup- :d steam does away very largely with steam ;, as it accomplishes the same result in a more .t manner and so reduces the cost of construc- It is a mistake to think that superheated steam be applied to pumps. The same principle that to the wasteful engine applies to the pump. ore wasteful the engine or pump, the more can ed by using superheated steam; consequently ving is more marked with pumps than with s. In the ordinary simple or compound engine, 'ing will be from 10 to 25 per cent by using sup- :d steam. On ordinary steam pumps, the is greater, as in this type of engine the cyl- condensation is ordinarily very high and tests hown a saving of 40 per cent of the steam con- on by the application of superheated steam.

:n saturated steam is used, the condensation is orated by heat from the steam jackets. On the nand when superheated steam is used, there is surplus of heat in the steam at the beginning of oke that at the end of the stroke the tempera- ıas fallen to a point sligthly below that of ısation, thereby reducing very largely the con- on in the cylinder. In general, the duty of can be increased from 10 to 40 per cent by the substitution of superheated for saturated

steam turbine presents a condition where sup- :d steam is a practical necessity, and the diffi- of lubrication as claimed by many engineers superheated steam is used, due to the taking the oil by the high temperature and dryness of :am, has been solved by the steam turbine, as s no risk in initial condensation at the admis- ıd of the engine. Experiments show that super- steam does produce an increase in the efficiency turbine, due apparently to the decrease of the .l friction between the moving blades of the ıe. An actual test showed that 1.5 horsepower cessary to run a turbine to speed with saturated under a vacuum, while only .90 horsepower ed when steam was superheated 300 degrees F. ndensing the exhaust of a steam turbine, its ıy is increased to an extent even greater than steam engine, consequently a good vacuum is ant. This is not difficult, as superheated steam, e of its greatly reduced density always produces :r vacuum, and a given volume of superheated occupies much less space when condensed than an equal volume of saturated steam.

:rheated steam has a useful part to perform a higher temperature than that due to a safe g pressure is desired; this applies to chemical ıhments, cooking ovens, etc. Exhaust steam is nes superheated for this purpose.

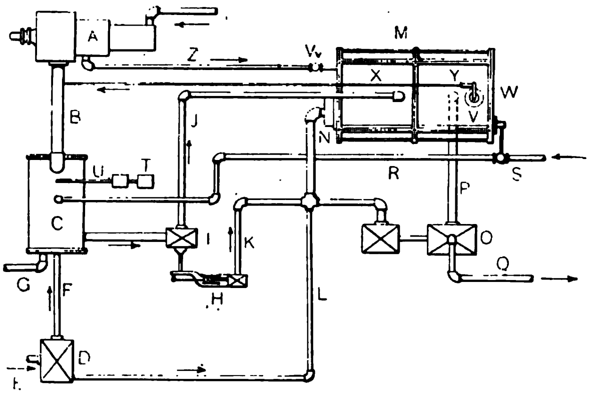
ıiderable light is thrown on the question as to ıuch moisture is contained in steam by the use erheated steam, as for instance, at a working :e of 125 pounds, 1 per cent moisture would 'nt 20 degrees of superheat. Under the best of ons of properly proportioned and well covered ipe a loss of 1-5 or 1-3 of a degree F. of super- :r foot of steampipe would occur; therefore, it onable to assume that the pipe loss would reach :e F. for every foot with the ordinary large pipe covered in the usual way. A pipe 100 feet long could lose 100 degrees of superheat, which corresponds to 5 per cent of moisture, assuming the steam was dry when it left the boiler.

The distrust as to the evil effects of superheated steam is fast disappearing, and the day is not far distant when the majority of engineers will understand superheated steam as thoroughly as they now understand saturated steam.

INSTALLATION OF OPEN HEATER WITH TURBINE OR ENGINE RUNNING CONDENSING.

Among the new problems and opportunities presented by the recent commercial development of the steam turbine is the application of the auxiliary equipment in plants operated by turbines. The Harrison Safety Boiler Works of Philadelphia, Pa., manufacturers of the well-known Cochrane feedwater heaters, have paid special attention to the adaptation of their Cochrane heaters to such plants (the actual and contemplated installations of these heaters in connection with steam turbines already exceeding 25,000 horsepower), and they have developed some features in these installations which should prove of considerable interest to engineers.

The accompanying illustration shows an approved method, designed by the Harrison Safety Boiler Works and covered by letters patent, for heating and regulating the boiler feedwater, and is particularly adapted to plants where the steam turbines are operated in connection with surface condensers, although this method is also applicable to plants where surface condensers are used in connection with reciprocating engines.



HEATER AND CONNECTIONS TO TURBINE AND AUXILIARIES.

A is the main steam turbine taking steam through the pipe from the boiler.

B is the exhaust pipe from the turbine to condenser.

C is the surface condenser receiving the exhaust from *B*.

D is a pump taking cold water through suction pipe *E* and forcing it through pipe *F* into the condenser to condense the exhaust steam therein; *G* is the discharge for the circulating water from the condenser.

H is an auxiliary engine driving a pump *I* for drawing the condensation of the steam from the condenser and delivering it to the open heater through the pipe *J*. *K* is the exhaust pipe from this auxiliary engine joining the exhaust *L* from *D*.

M is a Cochrane feedwater heater receiving the exhaust from the auxiliaries through the oil separator *N*.

O is a pump taking the feedwater from the heater through the pipe *P* and discharging it to the boilers through the pipe *Q*. The exhaust from this pump, joining the other auxiliary exhaust, enters the separator *N*.

R is the supplementary cold water feed supply emptying into the condenser *C* to make up any difference between the quantity of the condensation of the steam and the amount of water required by the boilers. The supplementary water is controlled by the valve *S*, according to the level of the water in the heater *M*. This valve is automatically closed or opened by the float and connecting mechanism.

T is an air pump exhausting air from the condenser *C* through the pipe *U*. In cases where this pump is steam driven, the exhaust also enters the separator *N*.

V is the exhaust from the heater to the atmosphere and is provided with a back pressure valve *W*.

X is an air pipe leading into the condenser and provided with the air valve *Y* for passing to the condenser the air which is liberated from the water by heating it in the heater. By this means the air in the heater is disposed of without permitting the escape of steam.

Should there be more exhaust from the auxiliaries than can be condensed in the heater, the pressure increases until it is high enough to open the back pressure valve *W* and allows the surplus to escape to the atmosphere. It often occurs, however, that the steam from the auxiliaries is insufficient to heat the feedwater to the temperature of the steam itself. In order to cover such cases the pipe *Z* is carried to the heater from such a point of expansion in the turbine as will insure the least loss of effectiveness with the greatest potentiality for the purpose of making up any possible deficiency in the auxiliary exhaust. In the pipe *Z* is placed an automatic throttling valve *Vv*, so adjusted that the pressure of the steam when it enters the heater shall be below the pressure at which the back pressure valve *W* is set. Thus the supply of supplemental steam from the turbine depends upon the pressure in the heater and is regulated by the needs of the heater itself.

The operation of this novel arrangement has important advantages. In addition to all of the condensation of the main exhaust being utilized in the heater, the supplementary cold water is automatically regulated and supplied, and is partially heated in the condenser by the utilization of the latent heat in the main exhaust. All of the exhaust from the auxiliaries is utilized up to the point where they provide more exhaust than is required in the heater, and should the supply fall below the maximum quantity required it is automatically supplemented by steam in the manner already described. The boilers are furnished with water at a uniformly high temperature, there being no sudden fall in the temperature due to variations in the quantity of steam available, for heating the water or in the quantity of the supplemental cold water required. The methods by which these desirable results are obtained are simple, positive and entirely automatic.

It will be seen that in a plant in which this method of heating and regulating the boiler feed supply is used the auxiliaries are of the independent, steam driven, noncondensing type. The manner in which the exhaust from these auxiliaries is utilized, however, makes them far more economical than the turbine or main engine run condensing, even though the latter may show an efficiency of 15 per cent or better. If the auxiliaries were run condensing they could not exceed and probably would not equal this efficiency of 15 per cent, but when operated in the manner described above, their efficiency is practically 100 per cent, for all of the heat in the steam which is not converted into work or accounted for by losses from radiation, etc., (and these quantities would be identical whether the auxiliaries were run condensing or noncondensing), is utilized in heating the feedwater and turned back into the boilers. This efficiency of 100 per cent compares with the absolute loss of 85 per cent which must occur if the auxiliaries are run condensing and the heat in the exhaust dissipated and wasted in the condensing water.

PROPORTIONING RADIATION SURFACES.

BY GEO. G. BENNETT.

We often hear steam engineers, especially those who are not familiar with steam heating, ask "Why is it necessary to increase the heating surface of a coil or radiator, when the room or building is required to be heated to a higher temperature?" They seem to think all that is to be done, is to increase the steam pressure. Increasing the steam pressure will answer to a certain extent and that only when the raise in temperature is very small. For instance: If 80 square feet of radiation is required to heat a room to 70 degrees in zero weather, what would be the temperature of the room if we raised the steam pressure to 50 pounds? Supposing the steam pressure first carried was 5 pounds: steam at 5 pounds pressure equals 228 degrees, and the temperature of the room equals 70 degrees. The difference of temperature between the air in the room and the steam is equal to 228—70=158 degrees. Prof. Baldwin's formula is, "Divide the difference in temperature between that at which the room is to be kept and the colder outside atmosphere, by the difference of the steam pipes and that at which you wish to keep the room. The product will be the square feet or fraction thereof of plate, or pipe surface, that is the equivalent of each square foot of glass or its equivalent in transmitting cold." Then if we divide 70 by 158 we get .443 of a foot of plate or pipe surface. Heating the room with a pressure of 50 pounds, we have (temperature of steam at 50 pounds pressure equals about 297 degrees). Then 297—70=227, the difference, and 70÷227=.308 the square foot of plate surface. Suppose that the glass equivalent of a room equals 180 square feet? Then, if we multiply the glass equivalent by .443 for the former case, we have 180×.443=79.74, or say 80 square feet. For the latter we have, 180×.308=55.44 square feet. It will be seen from the foregoing that it requires considerably less heating surface to heat the same room under an increased pressure.

To learn how much the room would be increased in temperature by leaving the 80-foot radiator in the room, and increasing the pressure of steam from 5 pounds to 50, proceed in this manner: It took 158 heat units per square foot of pipe surface, or 80×158=12,640 heat units to raise the temperature of the room from zero to 70 degrees. Now we have raised the pressure of the steam from 5 pounds to 50, so that each square foot of pipe surface will now give off 297—70=227 heat units, an increase of 69 heat units, or the total equals 227×80=18,160 heat units, or about 69 per cent gain, by increasing the pressure of the steam from 5 pounds to 50. So that the room will be increased from 70 degrees to about 100 degrees. The above calculations are based on theoretical conditions.

It will be seen from the above, that to increase the temperature of a room from a given temperature, other conditions remaining the same, we must either increase the pressure of the steam, or increase the size of the radiator, because, first, each square foot of radiation will only give off to the air surrounding it, so many heat units per hour, due to the difference between the steam in the radiator and the air in the room.

Second, if we wish to transmit a greater number of heat units in a given time, we must make some changes, *i. e.*, increase the capacity of the heater, or raise the pressure of the steam, or in other words, we have got to produce a greater difference between the two temperatures, the steam pipe and the air. As mentioned in the fore part of this paper, it requires about one half square foot of pipe surface to counteract the cooling effect of the glass, or its equivalent, with the temperature outside at zero and inside at 70 degrees, but, if the temperature is changed either inside or outside, *i. e.*, if the temperature outside should raise to 20 degrees above zero, the same amount of heating surface would raise the temperature inside the room, because the cooling effect of the outside air would be less, on account of the outside walls and windows becoming warmer. Therefore the temperature inside the room would raise in proportion.

Suppose we take a corner room, 12x12x10 feet. It contains four windows of 25 square feet each. The outside walls will equal 240 square feet, the four windows will equal 100 square feet, and the cubical contents equals about 7 square feet. The total glass equivalent will equal about 100+24+7 or about 131. The rule for finding the above is, to the glass add 1-10 the wall surface, add 1-200 the cubical contents. Thus the windows=100 square feet, the walls =240÷10=24 and the cubic contents=1,400÷200=7. Total 131 square feet of glass. We found by Prof. Baldwin's formula, that the square foot of pipe surface necessary to counteract the cooling effect of the glass would be equal to .443 of a foot. It must be remembered that this is the theoretical amount, and no allowance has been made for bad construction of the building such as loose windows and doors. The amount generally allowed is from 25 to 50 per cent. In my experience I have found that 30 per cent is a fair average, and will answer for all ordinary conditions, that is, use .575 or .6 as a multiplier for the glass. For the present demonstrations I will use the theoretical quantity. Now we found the glass equivalent to be 131 square feet; this multiplied by .443=58.033, the heating surface required, but it is not very often we can find a radiator with just that amount of radiation. The radiators are generally made in loops of 4, 5 and 8 square feet. So we will have to decide on a radiator of 56 or 60 square feet. If I were the heating engineer I would specify 60 square feet because it is not very often that the owner objects if the radiator is a little too large, but it is a different thing if the room cannot be heated to the specified temperature.

It will be found easy to turn off a radiator if the room becomes too warm, but we cannot turn more heat on if the radiator is not large enough, so it is better to be on the safe side.

To illustrate the subject a little further. It is required to heat the same room to a temperature of 200 degrees inside, the temperature remaining the same outside. How much radiation will have to be placed in the room?

Using the same formula as in the previous question, we have temperature of the steam 228 degrees, temperature of the room 200 degrees and temperature of the outside, zero. Then 228—200=28 degrees, the difference. 200÷28=7.14+, the square feet of pipe or radiating surface, necessary under the present conditions, to counteract the cooling effect of the outside walls and windows. In the former problem the difference between the inside and the outside temperature was only 70 degrees, while in this case the difference is 200 degrees, therefore it will require more heating surface to counteract the cooling of the glass or its equivalent. In other words to meet the new conditions we have had to increase the heating surface of the radiator from .443 square feet to 7.15. Now the amount of radiation that will be found necessary to heat the room to 200 degrees will be the glass equivalent 131 square feet, multiplied by 7.14 or 935.34 square feet, instead of 60 square feet as in the former case.

Now let us reason this proposition out. The amount of heat given out by a radiator or coil of steam pipe is the correct measure of the work done and by figuring from the difference between the steam and the air in the room to be heated, is the only way in which we can arrive at the solution of the problem. In the former proposition the difference between the steam pipe and the air in the room was 158 degrees, while in the latter it is only 28 degrees. Now, it is obvious that it would require a greater number of square feet of heating surface to supply the heat units necessary in the latter case than it would in the former, because in the former case each square foot of heating surface would give off to the surrounding air 158 heat units, and in the latter only 28. The difference between the inside and the outside temperature in the former proposition was only 70 degrees, while in the latter it is 200 degrees. We have increased the temperature of the room to 200 degrees, but the temperature of the steam pipe has remained constant. It only goes to prove that the closer we arrive at the temperature of the room and the steam pipe, the greater must be the amount of heating surface in the steam pipes.

Let me give another demonstration. It is desired to heat the same room to 226 degrees, conditions remaining the same as in the former case. Temperature of room 226 degrees, temperature of steam 228 degrees and outside temperature, zero. Difference between steam pipe and room 2 degrees. Difference between outside temperature and inside or room 226 degrees. Then we have 228—226=2 degrees, the difference between the temperature of the room and the steam pipe. 226÷2=113, the amount of radiating surface required at the present time to counteract the cooling effect of the outside walls and windows. Now you will begin to see why it requires such an extraordinary amount, or increase in the heating surface, to heat the room to 226 degrees.

The amount of radiating surface to heat the room will be: Square feet of glass 131, multiplied by 113 equals 14,803 square feet, the amount of radiation to be placed inside of the room to heat it to temperature of 226 degrees.

Note the difference in the amount of heating surface. When we are required to raise the temperature of the room 2 degrees or from 226 to 228 degrees, we have: Temperature of room 228 degrees; temperature of the steam pipe 228 degrees; difference, nothing. Difference between the inside and the outside temperatures, 228 degrees. Then we have temperature of room 228 degrees minus the outside temperature of 228 degrees or nothing. Difference between the inside and outside temperatures 228 degrees. Then we have the following number of square feet of pipe, or radiating surface: 131×228=29,868 square feet. This amount must be placed in the room, to heat it to 228 degrees.

This shows that in order to raise the temperature 2 degrees, we must increase the square feet of radiation from 14,803 to 29,868; more than double the amount. This tremendous increase is due to the great difference in the steam pipe and the outside temperature. The fact of the matter is, we have made the walls of the room as hot as the steam pipe. While this is not absolutely correct, it is approximately true.

The following tables will be found very convenient for ready reference, both for steam and hot water. The tables are determined from Prof. Baldwin's formula, given in the beginning of this paper. Steam at a temperature of 212 degrees:

For Temperature Above 70 Degrees.

Room to be heat to	70°	Steam at 212°	Ratio	.493
"	80°	"	"	.606
"	90°	"	"	.737
"	100°	"	"	.889
"	120°	"	"	1.326
"	130°	"	"	1.586
"	140°	"	"	1.944
"	150°	"	"	2.410
"	160°	"	"	3.076
"	170°	"	"	4.047
"	180°	"	"	5.625
"	190°	"	"	8.636
"	200°	"	"	16.666
"	210°	"	"	105.000
"	212°	"	"	212.000

For Temperature Below 70 Degrees.

Room to be heat to	65°	Steam at 212°	Ratio	.457
"	60°	"	"	.422
"	55°	"	"	.387
"	50°	"	"	.352
"	45°	"	"	.316
"	40°	"	"	.281
"	35°	"	"	.246
"	30°	"	"	.211
"	25°	"	"	.176
"	20°	"	"	.140
"	15°	"	"	.105
"	10°	"	"	.070
"	5°	"	"	.035
"	0°	"	"	.000

When estimating the radiation for rooms and buildings add 30 per cent to the above constants. To illustrate: Required that a room shall be heated to 30 degrees, outside temperature, zero; steam at 212 degrees. Estimate the amount of radiation, using the same room as we did in the previous propositions; it contained 131 square feet of glass equivalent. Referring to the table, we find opposite 30 degrees the constant .211. To this add 30 per cent and we have .274 and 131×.274=35,849 square feet of radiation required to heat the room to 30 degrees in zero weather.

REVISED MUNICIPAL CODE FOR ST. LOUIS

The following is a notice to boiler users which is a step in the right direction:

Gentlemen:—Notice is hereby given you that from and after this date, all boilers built for use in the City of St. Louis, having cylindrical shells or drums of more than 42 inches diameter, and carrying more than 15 pounds steam pressure to the square inch, must have all longitudinal seams butted and held together by straps riveted over them. Where single butt straps are used, they must not be less in thickness than the shell plates, and where double butt straps are used, each strap or cover, must be no less than five-eighths of the thickness of the shell plates.

Plans and specifications of all boilers required by Revised Section No. 2236 of the Municipal Code to be submitted to this office upon award of contract, must comply with above regulations, or same will not be approved.

Respectfully,
Jos. G. Branch,
Inspector of Boilers and Elevators.

AN INGERSOLL WATCH FREE.

The Strong Machinery & Supply Co., for the last seven years at No. 2½ Murray street, have recently moved to their new and larger quarters at No. 48 Franklin street, where they are prepared to take care of their customers in much better shape. This company carries the largest stock of packings in the East, making a specialty of handling every kind, grade and make of packing for steam, water, gas, hydraulic and special purposes, on the market. The are, at the present time, making a special push on Strong's Rivalate fibrous metallic packing, which is said to be one of the best all-round friction reducing packing in the world.

This packing is made in the shape of long threads and is put in cans, with the result that any size of rod, any size of box for steam, air, gas, oil or ammonia can be instantly packed without measurements of any kind. This packing, once set to its place, is, to all intents and purposes, a solid metallic packing, as the fibers next the rod take a smooth, glassy surface, making the lightest friction reducing packing in the world.

This packing, they inform us, can be removed at any time, with an ordinary packing hook.

They are at present offering as a special premium for the first trial order, one of the Ingersoll $1.50 guaranteed watches.

Their results in some of the largest plants of the world have been most gratifying and they will gladly send a can on approval to any responsible house for the purpose of thirty days' trial.

A NEW STOKER FURNACE.

The stoker furnace herewith illustrated is of the type designated as "automatic" in distinction from those which must be cleaned by hand. The coal magazines and stoking apparatus being located along the entire length of each side of the fire chamber gives ample length of feed plate so that the largest quantity, even to 40 pounds or more, it is said, of coal can be fed per square foot of grate per hour and yet be pushed over the feed or coking plates so slowly that the volatile gas is thoroughly extracted and burned by the time the coal is fairly on the upper end of the grates, and for this reason there is little or no smoke even when "crowding" the boilers. The grates are arranged as shown in Fig. 1, on either side in pairs, one of each pair being moved up and down by the rocker bar on either side of the bearer, occupying the longitudinal center of the furnace. This shear-like action of every other grate bar sifts the fine ash through between the grates into the ashpit and prevents sticking, while the weight of the green coal at the top, with the positive push of the stoker boxes, keeps the coal, clinker and other coarse refuse moving down toward the center, where the clinker and refuse is ground into the ashpit by the constant rotary motion of the clinker bar. This bar rotates in the center, longitudinally of the furnace, and just sufficiently below the level of the grate surface to form a box-like receptacle from which the clinkers and coarse refuse are ground out without disturbance of the fire and with unequaled low percentage of waste in the ash. The longitudinal view is shown in Fig. 2.

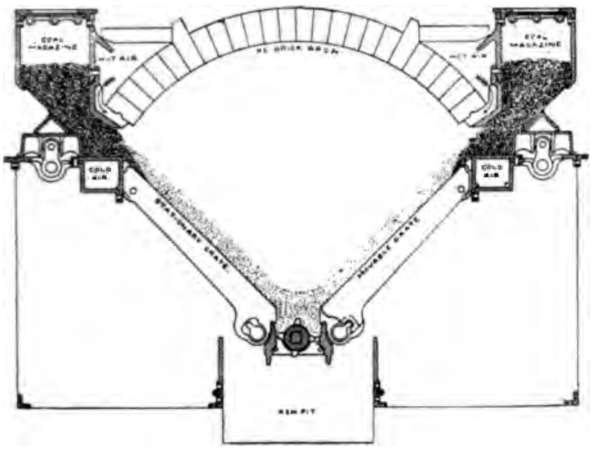


FIG. 1. INTERNAL ARRANGEMENT OF FURNACE AND MANNER OF FEEDING COAL.

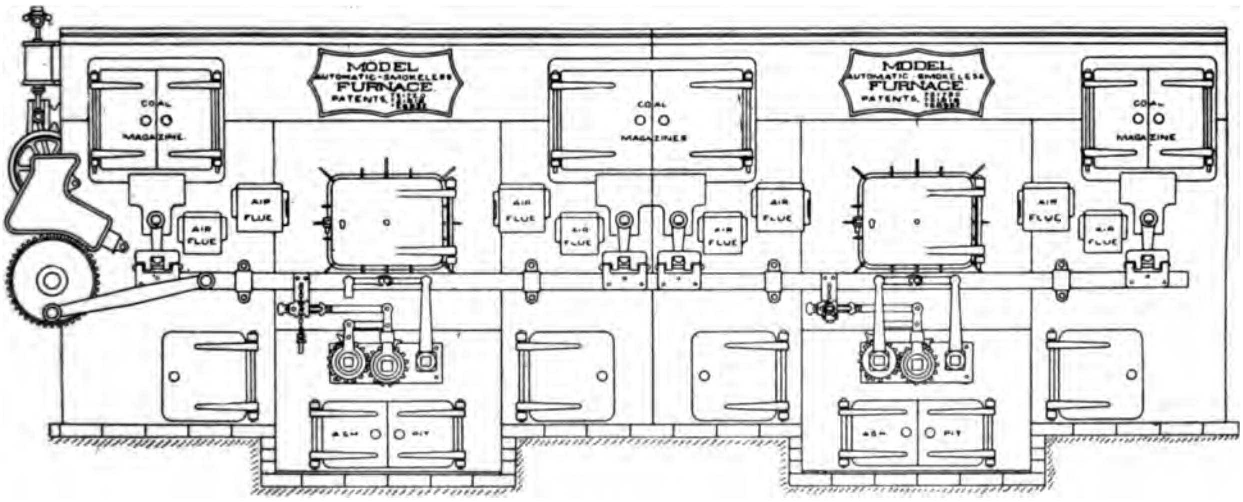


FIG. 3. BATTERY OF BOILERS SHOWING STOKER ARRANGEMENT AND ENGINE.

The form and arrangement of the grates is such that a very narrow surface is exposed to the fire while the wide surface of each grate is acted upon by the draught of air through and between the grates, and thus satisfactory durability is secured.

The special features of this furnace, set forth by the manufacturers, as compared with others of like type, are the perfection of its self-cleaning, small per cent of unburned fuel in the ash and improved construction, reducing the cost of renewals to a low minimum.

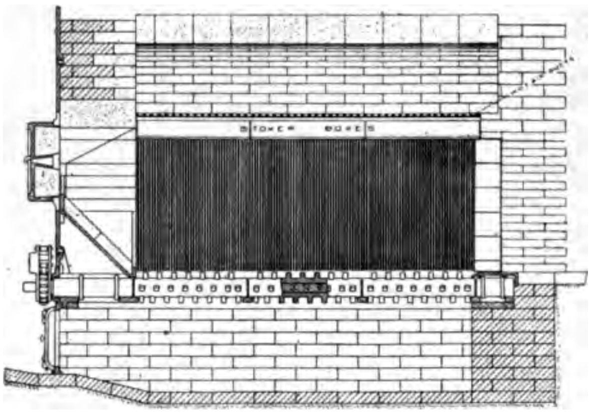
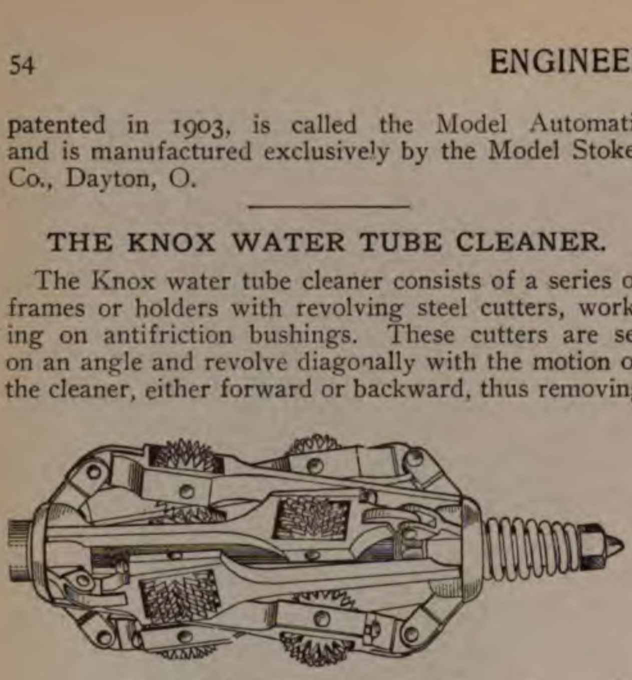


FIG. 2. LONGITUDINAL VIEW OF GRATES, AIR DUCTS AND CLINKER BAR.

A battery of two or more of these furnaces can be operated by the one little engine and the double set of worm gears which are furnished with each furnace or battery. The engine may be located on either the right or left corner of the battery, and is shown in Fig. 3. The engine is 3½ x 5-inch and uses only a half to 2 horsepower of steam per furnace, according to size and rate of duty. Any working part of this furnace can be detached at any time without interfering with any other part, and any or all parts can be operated by hand. Any pair of grates or other working part exposed to the heat of the fire can be renewed without putting the furnace out of service or materially interfering with its working duty. This furnace was patented in 1903, is called the Model Automatic and is manufactured exclusively by the Model Stoker Co., Dayton, O.

THE KNOX WATER TUBE CLEANER.

The Knox water tube cleaner consists of a series of frames or holders with revolving steel cutters, working on antifriction bushings. These cutters are set on an angle and revolve diagonally with the motion of the cleaner, either forward or backward, thus removing the scale formation, with ease and rapidity. The cutters do not injure the tubes in any manner, as they are adjusted by elastic spring tensions. It is convenient and is always ready for service, as it does not get out of order and requires no fitting up to operate. The illustration shows the cleaner, which is manufactured by the Hubbard Co., Washington, D. C.



THE KNOX WATER TUBE CLEANER.

THE TRIMO MONKEY WRENCH.

The Trimo wrench, shown herewith, is new and has all of the good points of the usual monkey wrench with several additional ones. Among other claims of the manufacturers are that it is almost impossible to break it or to even spring the jaws; also that they wear like steel and will not even wabble under severe pressure. It will be seen that the leverage of this wrench is increased in proportion to the size of the nut it is used upon, as the jaw is extended forward in making the adjustment. This wrench is manufactured by the Trimont Manufacturing Co., Roxbury, Mass.

TRIMO
TRIMONT MFG CO. ROXBURY, MASS. 12

THE TRIMO MONKEY WRENCH.

NEW BOOKS AND CATALOGS.

AN ATTRACTIVE little bulletin No. 103, has been sent us recently by the Quincy Engine Works, Quincy, Ill. This booklet gives several interesting points concerning Quincy engines. Several fine cuts of their different types of engines are shown together with tables enabling a prospective purchaser to select an engine meeting his requirements. The vertical engine manufactured by this concern is noted for its small and compact foundation area, below, frictional resistance of its pistons in the cylinders and the ease with which its reciprocating parts in cylinder heads may be handled in case of repairs. This catalogue will be furnished to any engineer upon application.

THE ADVANTAGES of Crandall packings are set forth in a neat little catalog, a copy of same having been recently received. The Crandall Packing Co. have maintained a high standard of quality in their packing against the most active competition. Special attention is called in this catalog to their packing for steam, hydraulic, ammonia, high pressure work, etc. They solicit correspondence, and requests for catalog or samples and prices will be gladly answered and full information concerning their goods and their uses will be furnished. This firm has offices in Chicago and New York, but correspondence should be addressed to their main office at Palmyra, N. Y.

"YOU TAKE NO CHANCES" is the subject of a leaflet issued by the Fisher Governor Co., 1202 Main street West, Marshalltown, Ia. It calls special attention to the Fisher reducing valve which is in the angle and globe patterns. Where these reducing valves are not known they offer to ship same on 30 days trial to be returned at their expense if they do not give satisfaction. Information concerning this reducing valve also their pump governor will be gladly furnished upon application.

THE VIGILANT feedwater regulator is fully described in a recent catalog. An interesting feature of this catalog is a long list of prominent firms in the United States which have repeated their first order for the regulator manufactured by this concern. For further information address the Chaplin-Fulton Mfg. Co., 100 Penn avenue, Pittsburg, Pa.

"LET'S TALK IT OVER" is the text for an interesting little heart to heart talk supposed to take place between two engineers, printed on a little circular which is being distributed by the Lagonda Mfg. Co., of Springfield, Ohio. The engineer in this little story is so well pleased with his Weinland tube cleaner that he describes its merits to his freind. Send for this little story and their large catalog.

THE HOISTING PROBLEM is dealt with in a leaflet issued by the Columbus Machine Co., Columbus, Ohio, which gives the size and dimensions of the Columbus gas engine hoists.

CATALOG NO. 60, issued by the Hartford Blower Co., Hartford, Conn., describes their mechanical draft apparatus. The last page of this book gives a few advantages of the Hartford over other blowers. They solicit correspondence in regard to their products.

GAS AND GASOLINE engines for use any where that power is needed are manufactured by the Williamsport Gas Engine Co., Williamsport, Pa. Their engine is fully described in their latest catalog.

A CATALOG has been received from the American Steam Pump Co., of Battle Creek, Mich. The general design of the Marsh standard boiler feed pumps sizes B to R and capacity ranging from 10 to 3.500 horsepower are fully illustrated in this booklet. Their special pump catalog will be sent to any address upon request.

"BELMONT" PACKING is fully described in booklet A, issued by Clement Restein & Co., Philadelphia, Pa. They call special attention to the fact that their packings are reliable and that one discount will give you their lowest net prices for everything.

THE KEARNEY ELECTRIC CO., 60 Miami avenue, Detroit, Mich., are sending out a booklet entitled "Look Into It." This booklet contains copies of a few testimonial letters they have received from customers using their commutator compound, Ebonite. A sample stick will be furnished upon request.

THE MONTHLY RECORD of Scientific Literature published by D. Van Nostrand & Co., 23 Murray and 27 Warren streets, New York, has been recently received. This record contains information about new and old scientific works with full lists of books upon special subjects and notices of contents of the more important ones. It will be sent gratis upon application.

"A FEW BOUQUETS" is the title of a lavender colored booklet issued by the A. A. Griffing Iron Co., 444 Communipaw avenue, Jersey City, N. J. This presents a few testimonials from their satisfied customers.

A NEAT dodger received from the C. H. Wheeler Condenser & Pump Co., Philadelphia, announces their purchase of the Barr Pump Co. They solicit inquiries for all kinds of condensing and pumping engines.

THE HISTORY of the first Corliss engine made by Geo. H. Corliss more than 50 years ago is outlined in an attractive catalog being sent out. Much information concerning this type of engine is furnished in this catalog which can be procured by addressing the Rickard Corliss Engine Works, 4041 N. 5th street, Philadelphia, Pa.

GAS PRODUCERS are fully described in catalog B of the Wile Power Gas Co., of Rochester, N. Y. They guarantee every gas producer sold by them to properly perform the service for which it is intended. Further information gladly furnished upon request.

A HANDSOME little catalog with an embossed cover which is No. 16 D has been recently received from the Canton Pump Co., of Canton, Ohio. This catalog furnishes much information concerning their pumps, giving specifications and prices on the different sized pumps which they manufacture. Two of the pages are taken up, one with an illustration of the exact number of parts of their duplex pumps with each part numbered making it an easy matter to order repairs by simply referring to the catalog. A special feature of their single cylinder, or simplex steam pump is that it contains so few working parts having no outside valve gear. They will gladly furnish this catalogue to any one interested.

THE 34th edition of the catalog of the Abendroth & Root Mfg. Co., 99 John street, New York City, is now ready. It contains numerous illustrations of fine buildings using their water tube boiler. Considerable practical information and tables of much value to any engineer is included. By mentioning this journal a copy of the catalog will be sent to any address.

THE STEWART HEATER CO., 160 Norfolk avenue, Buffalo, N. Y., have recently issued a revised and illustrated catalog of their power pumps and Otis feedwater heater, oil separator and filter. Any one interested can receive descriptive circulars and price list by writing this company.

THE LATEST BULLETIN of the Union Steam Pump Co., Battle Creek, Mich., manufacturers of the Burnham steam pumps contains many useful suggestions. In the center of the bulletin is left blanks for a memorandum book.

"WORTH WINS" is the title of an instructive little booklet being distributed by the Golden-Anderson Valve Specialty Co., 200 Pike street, Pittsburg, Pa. This is pamphlet No. 1 for 1905. It fully describes the Anderson cushion triple acting non-return valve, Anderson reducing valve and the Golden patent tilting steam trap. They will be glad to furnish much more information concerning their products and also send their catalog.

ATTENTION OF THE trade is called to the large variety of patterns for drainage fittings in a catalog issued by the Pittsburg Valve & Fittings Co., Frick Bldg., Pittsburg. They guarantee all their patterns to be correctly threaded and of new and correct design.

A BULLETIN issued by the Cookson Steam Specialty Co., 326 W. Fourth street, Cincinnati, O., describes their improved steam trap. The pamphlet is illustrated showing the different parts and sectional cuts of this steam trap.

FULL INFORMATION concerning the American steel pulleys, their capacity and price list can be secured by obtaining the latest leaflet issued by the American Pulley Co., 29th and Bistol streets, Philadelphia, Pa.

"HOW ONE MAN Can Do the Work of Two" is explained in a folder received from the Toledo Pipe Threading Machine Co., Toledo, O. The "Toledo" manufactured by this concern is a new device for threading pipe by hand. It is constructed on a principal that will instantly convince mechanical men of its correctness and superiority. It is stated that with one of their machines one man can easily thread a 4-inch pipe and have it absolutely accurate. A distinctive feature of the "Toledo" is the opening or expanding of the dies as the tool progresses on the work, insuring a proper taper to correspond with standard pipe threads.

PREVENTING AN ACCIDENT is better than insuring boilers and engines against accidents. A circular describing how to accomplish this end is being sent out by the Consolidated Engine Stop Co., 100 Broadway, New York.

EVIDENCE OF THE SATISFACTION derived from using Sterling lubricators is shown in the booklet which has been issued by the Sterling Lubricator Co., Rochester, N. Y. This gives a list of the users of the Sterling lubricator and includes many large firms throughout the country all of whom seem to be well pleased with the results obtained from the use of these appliances.

ATTENTION IS CALLED to Diesel engines through a circular being sent out by the American Diesel Engine Co., 11 Broadway, New York.

CATALOG NO. 8, pocket size for 1905, is now being distributed by the William Powell Co., 2525 Spring Grove avenue, Cincinnati, Ohio, manufacturers of high grade steam brass goods and specialties. All of their specialties, valves, lubricators and oilers are very fully described in this catalog which will be sent on application.

ONE OF THE MOST attractive catalogs which has been brought to our notice was recently received from the Aultman & Taylor Machinery Co., Mansfield, Ohio, manufacturers of Cahall water tube boilers. This is the fifth edition. It is put up in book form, coated book stock and contains 120 pages of matter. The catalog would be a very fine addition to any engineer's library. It contains much valuable information concerning the vertical and horizontal type of boilers manufactured by this company and can be secured by mentioning the Engineers' Review and requesting a copy.

MUCH PRACTICAL INSTRUCTION concerning steam gages can be secured by asking for catalog No. 3 from the Standard Gage Mfg. Co., Syracuse, N. Y. This catalog is very finely illustrated and is now ready for distribution.

THE BACHELDER PATENT adjustable spring indicator and other products of John S. Bushnell & Co., are very fully described in their latest preliminary circular and catalog which can be procured by addressing this firm at 123 Liberty street, New York.

LUNKENHEIMER REGRINDING VALVES are noted for their reliable, durable, servicable and practical construction. No radical change has ever been made in their construction which is sufficient guarantee for the correctness of the design. A complete catalog of engineering specialties can be obtained free for the asking from the Lunkenheimer Co., Cincinnati, O.

A HANDSOME BOOKLET received from the William Gage Co., 543 Fourth avenue, Pittsburg, Pa., gives a complete description and information concerning their economizing steam specialties. Many of their appliances would be a beneficial addition to a boiler room and they invite criticism for and against their specialties. Catalog furnished upon application.

A GRAPHIC ILLUSTRATION of the difference in the old and new method of stoking is very fully illustrated and described in a handsome booklet issued by the Wilkinson Mfg. Co., Bridgeport, Pa. This catalog sets out the advantage of an automatic stoker in the saving of fuel and the additional saving in labor, and will be furnished free upon application by mentioning this journal.

TRADE NOTES.

WE ARE INFORMED Mr. Charles Lang has been appointed New York representative of the C. H. Wheeler Condenser & Pump Co., of Philadelphia. His office is at 26 Cortlandt Street, New York. He will be glad to communicate with anyone in need of pumps.

OWING TO THEIR rapidly increasing business, the Reeves Engine Co., Trenton, N. J., have been compelled to move their sales department to more commodious quarters. Hereafter they will occupy a suite of offices on the seventh floor of the building at 85 Liberty street, New York.

THE BURT MFG. CO., Akron, O., have just shipped one of their large oil filters to the Munising Paper Co., Munising, Mich., and another to the Singer Sewing Machine Co. Both of these filters will be used in connection with the Siegriest oiling system.

ELSEWHERE IN THIS issue will be found the advertisement of Arizona Charter Corporation Guarantee Co. This company claims to have done the larger part of the corporation business in Arizona in the past and are fully equipped to attend to all such matters promptly and with entire satisfaction to those who may desire to form companies under the liberal laws of Arizona.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., in order to introduce their special packings are making a proposition that, we are informed, will appeal to every engineer. If you wish to know what it is, use the coupon at the bottom of their advertisement.

THE AMERICAN PULLEY CO., Philadelphia, Pa., are giving out to all who are prospective buyers and to those who are interested in pulleys, a handy measuring tape put up in a handsome spring case.

THE AMERICAN ENGINE CO., Bound Brook, N. J., are sending out as an advertising feature an atlas of the world containing colored maps of all the states and territories in the United States and the provinces of the Dominion of Canada, also full page maps of every country and civil division upon the face of the globe. It is published by Rand & McNally, and contains 100 pages. If you are interested better send for it.

THE MODEL STOKER CO., Dayton, Ohio. among others have recently taken two contracts, each for 1,200 horsepower which are of special significance. One contract is from the Geo. H. Friend Paper & Tablet Co. at West Carrollton (near Dayton) Ohio, and the other from the B. F. Goodrich Co. (Rubber Works) Akron, Ohio. Each of these firms have had several years' experience in the use of different forms of stoker furnaces, and each last year put in the Model Automatic on trial. These installations therefore made after thorough trial and comparison with other types and makes constitute demonstrations and endorsements, that seem to be unbiased testimony of the superior value of the Model Automatic which is both self-fed and self-cleaned.

THE PITTSBURG GAGE & Supply Co. have been awarded the contract for a very large oiling system to be installed in the new plant of the National Tube Co., Lorain, O. This is the most modern pipe manufacturing plant in the world and they have adopted the White Star oiling system.

THE GENERAL SPECIALTY CO., 73 Carroll street, Buffalo, N. Y., recently received the following letter from the Heidenkamp Mirror Co., Springdale, Pa.: "We are in receipt of yours of March 24th, but on account of a flood we had here during the latter part of last month, your letter was mislaid and hence the delay in answering same. You ask us whether the "Torpedo" scale remover which we bought from you a year ago is filling our expectation in every way and if we are satisfied with it. You bet we are satisfied with the machine. We operate nine boilers, 150 horsepower each and your machine has more than filled our expectation. It thoroughly cleans our boilers and accomplishes this without straining or injuring the tube in any way. We would not be without your machine."

THE GEO. W. LORD CO., of Philadelphia, manufacturers of water purifying chemicals, have since the first of the year made the following foreign shipments: 40,000 pounds to Montreal, Canada; 50,000 pounds to Madras, India; 30,000 pounds, to Liverpool, England; 30,000 pounds to London, England. This is a proposition that can be successfully handled over any distance. They do not have to know the general conditions met in any country. The individual sample of scale tells the whole story. It is carefully analyzed and then the Geo. W .Lord Co. are able to prescribe a compound that will successfully handle the conditions to be dealt with in that particular plant. The process is interesting and is fully described in either of two booklets one for the engineer and the other for the proprietor which will be sent free upon request, by the Geo. W. Lord Co.

THE STERLING LUBRICATOR CO., 5 Frank street, Rochester, N. Y., have just completed an installation of 30 Sterling lubricators in the power plant of the New York Stock Exchange. This is one of the most noted engine rooms in the world and contains about one million dollars worth of machinery.

HERFAFTER THE New York Safety Steam Power Co., of New York, manufacturers of engines and boilers, will be located at 114 Liberty street.

THE "NEW YORK SPECIAL" of the Pennsylvania Lines, leaves Cleveland 5:30 p. m., arrives New York 8:15 a. m. A Pennsylvania standard dining car. Through sleepers. Reservations at New City Ticket Office, 112 Euclid Avenue, Colonial Arcade. Geo. W. Weedon, Dist. Pass. Agent, Cleveland, O.

ANY ENGINEER who did not accept the offer of the Crandall Packing Co., Palmyra, N. Y., which appeared in the April issue of this publication still has an opportunity to do so. They agree to send a good engine room clock to every engineer who orders from them 25 pounds of packing. As their packings are high grade no engineer can feel that he is not getting full value in the packing alone, and can count the clock as clear gain. If you write them mention the Engineers' Review.

THE KEYSTONE LUBRICATING CO., of Philadelphia, have opened an office in New York city, room 205, 253 Broadway, with Mr. Wm. F. Bilyeu in charge. Firms interested in the famous Keystone Grease may get full information by communicating with him.

AT THE PLANT of the Pennsylvania R. R. Co., in Jersey City, for electric service the Zena Packing made the feed pumps tight when, it is said, no other packing would do it. To any engineer who is interested, full particulars as well as catalogs will be mailed upon receipt of postal (mentioning the Review) to Randolph Brandt, 38 Cortlandt street, New York.

JAMES McCREA & CO., manufacturers of steam specialties, 67 W. Washington street, Chicago, report that the following jobbers have placed orders for complete stocks of their Emergency pipe clamps, since January 1 of this year: Chicago Engineers' Supply Co., McMaster Davis Supply Co., Henion & Hubbell Co., and Advance Packing & Supply Co., Chicago; Plumbers & Steam Fitters' Supply Co., Minneapolis; Marshall-Wells Hdw. Co., Duluth; Somers Fitler & Todd Co., Pittsburg; W. Bingham Co., Wm. Pattison Supply Co., and Strong, Carlisle & Hammond Co., Cleveland; Stuart Machinery Co.. and Threshers' Supply Co., Winnipeg, Man.; Bridgman Bros., Philadelphia; Geo. I. Roberts & Bros., and John Sirmons Co., New York City; John S. Adt, Baltimore; E. Keeler Co., Williamsport, Pa.; The Huzzy-Lyon Co.. Detroit; Erie Mfg. & Supply Co., Erie, Pa.; Syracuse Supply Co., Syracuse, N. Y.; Central Supply Co., and Indiana Supply Co., Indianapolis; Smith-Courtney Co.. Richmond, Va.; Columbus Mill & Mine Supply Co., Columbus, O.; Cameron & Berkley Co., Charleston, S. C.; Hartfelder-Garbutt Co., Savannah, Ga.; I. M. Rumsey Mfg. Co., and Western Iron & Supply Co., St. Louis, Mo.; Cotton States Belting & Sup'y Co., Atlanta, Ga.; Crane-Hawley Co., Cincinnati, O.; Crane Co., Los Angles; Crane Co.. San Francisco; Crane Co., Portland; Crane Co., Seattle; Crane Co., Spokane, Wash.; Crane Co., Salt Lake City; Mine & Smelter Supply Co.. Denver and Salt Lake City; Hendric & Bolthoff Mfg. & Supply Co., Denver.

ON MAY 8, 1905, the Fisher Governor Co., 1202 Main street West, Marshalltown, Ia., entered the ten thousandth order for their pump governor. The business is practically 15 years old, the bulk having been done the past 10 years.

WE ARE PLEASED to announce the organization of the Golden-Anderson Valve Specialty Co., 200 Pike street. Pittsburg, Pa. Both gentlemen are well known in the valve manufacturing field having been engaged therein for many years. The new company will manufacture the Anderson non-return valve and other valves for different purposes, as well as the Golden tilting steam trap. These goods have been on the market for years and are guaranteed to give satisfaction if properly used. We bespeak for the new company a successful career. Their catalog is reviewed in another part of this paper.

FOR SALE.

An engineer or man experienced with steam boiler plants can purchase for $1,000.00 a profitable established business. Best reasons and every assistance given. Address "Business," care Engineers' Review.

WANTED.

Salesmen or agents to sell a patented specialty of great merit, for boilers, which is already being used by the largest concerns. Address Power Specialty Co., 513 Washington Arcade, Detroit, Mich.

REG U. S. PATENT OFFICE.

Strong's Rivalate Fibrous Metallic Packing

Is the most wonderful all around steam, ammonia, air, acid and oil packing on the market of the world.

STRONG'S RIVALATE FIBROUS METALLIC PACKING can be applied to any stuffing box, large or small, shallow or deep, without measurements of any kind—easily, quickly and permanently.

The fibres of STRONG'S RIVALATE PACKING will take a smooth, glassy surface on the rod while retaining their individuality back from the rod; thus making the most perfect self-lubricating and elastic metallic packing manufactured.

As an illustration of what this packing is doing in hundreds of the largest corporations, would state that we sold a can of this material to one of the largest mines in this country on the strength of the claims we made for it. They put it in a large pump in their mine which they have been unable to hold with any packing they had been able to buy more than one week at a time. STRONG'S RIVALATE has held this pump now over five weeks, and upon calling on the Superintendent, he stated that "*It seems too good to be true, but as it is working in our pump, I know it is true.*" They have not had the slightest leak since the pump was packed and it is, to all intents and purposes, good for the next two or three years to come.

This is but one illustration of hundreds all over this country. The packing is right, cheap, extremely economical and very, very durable. With a can of this packing in your engine room, you have a complete set of metallic, almost frictionless packing for any kind of an engine or pump, any depth of a box, any size of a box, equally well. One can covers everything. No measurements required with this packing. Price only $1.50 per pound. Can be instantly removed with ordinary packing hooks.

With a 15 pound pail of this packing, we will give, as a premium, one of the Ingersoll $1.50 guaranteed watches with the first order.

Write us for full information, circulars, etc., regarding this—
the most wonderful, friction-reducing packing on the market

Strong Machinery & Supply Co.

48 Franklin Street,

Telephone 4258 Franklin. NEW YORK.

A CLEAN BOILER

means more work, of course, at first; but it is easier to keep clean and gives one so much satisfaction that it is worth while for that alone. The use of

**INTERNATIONAL
Boiler Compound**

insures clean boilers—always. Besides that, we have a special offer which we are making engineers. Have you had it? If not, write at once.

International Boiler Compound Co.

47 MARKET STREET, CHICAGO, ILL.

THE USE OF THE

Reliance Safety Water Column

INSURES, AMONG OTHER THINGS

Steady Water **Less Repairs**
Steady Power **Less Stoppages**
Steady Steam Pressure **Less Fuel**
Less Expansion and Contraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

WRITE US FOR FURTHER INFORMATION

The Reliance Gauge Column Co.

86 E. PROSPECT ST. CLEVELAND, O.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.

Albany, N. Y., U. S. A.

Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

Starrett Speed Indicator No. 104

Price, Postpaid, $1.00

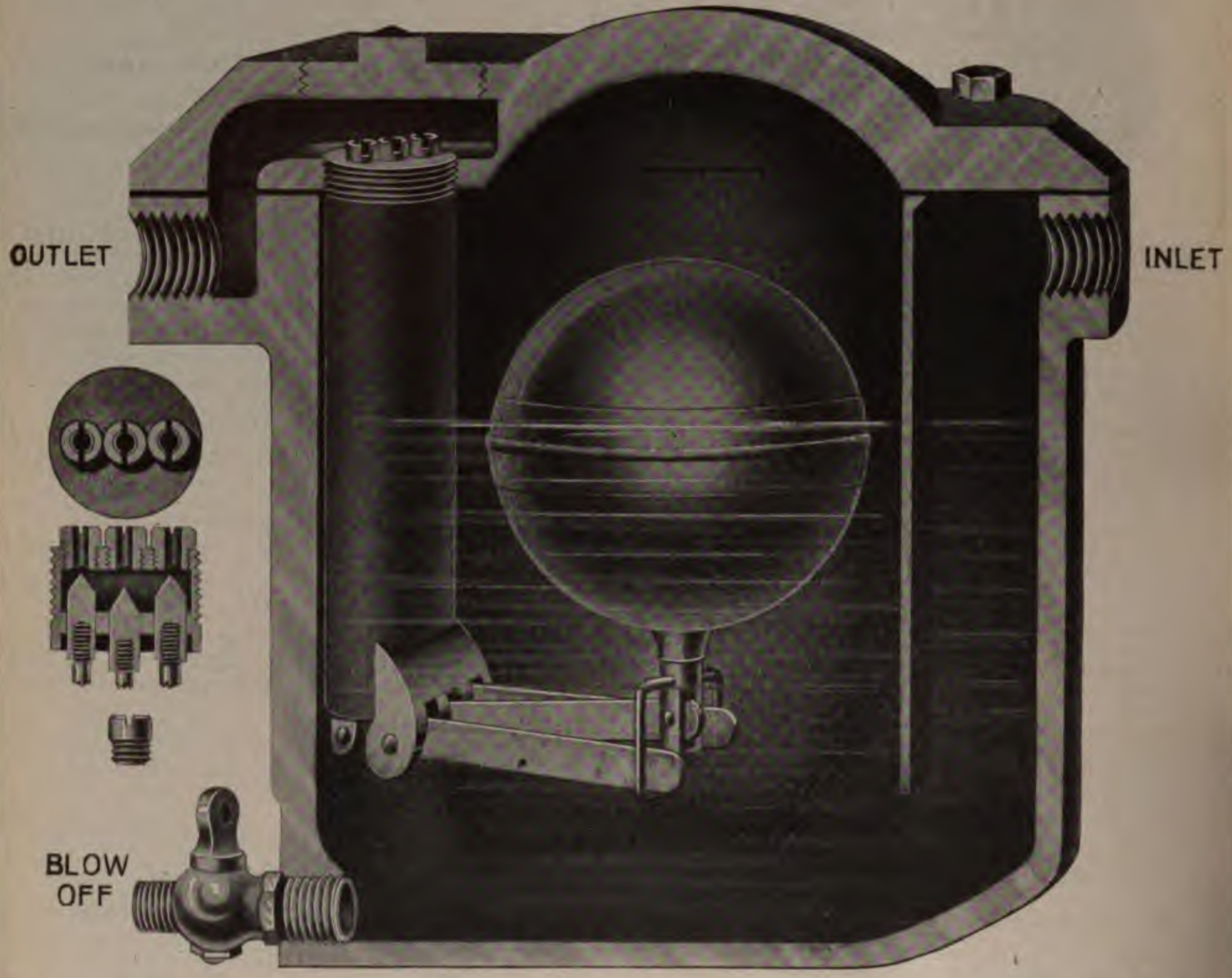
This Indicator may be run at highest speed required, without heating. The working parts are encased. Dial has two rows of figures, reading either right or left as shaft may run. Steel pointed spindle with rubber tips for both pointed and centered shafts. The 0 mark may be instantly set at the starting point.

Send for free Catalogue No. 171 of Fine Tools.

The L. S. Starrett Co., Athol Mass., U. S. A.

"There," said John Hancock

When he had signed his name in big letters to the Declaration of Independence, "King George will be able to read that without spectacles."
A similar desire prompts us to use this very large cut to show the working parts of



The Wright "Emergency" Steam Trap

We want to put the advantages of its construction before you so plainly that you won't need spectacles to appreciate their importance. Look a moment—no complicated mechanisms to get out of order; nothing to suffer from long, hard service, but every part strong and substantial. As for their ability to handle large amounts of water quickly without wasting steam, Wright "Emergency Steam" Traps have no superior. Our three-valve principle, found in no other trap, is the reason why. This, and all other details are fully described in our No. 9 catalog—may we send a copy?

Wright Manufacturing Company, 82 Woodbridge Street,
DETROIT, MICH., U. S. A.

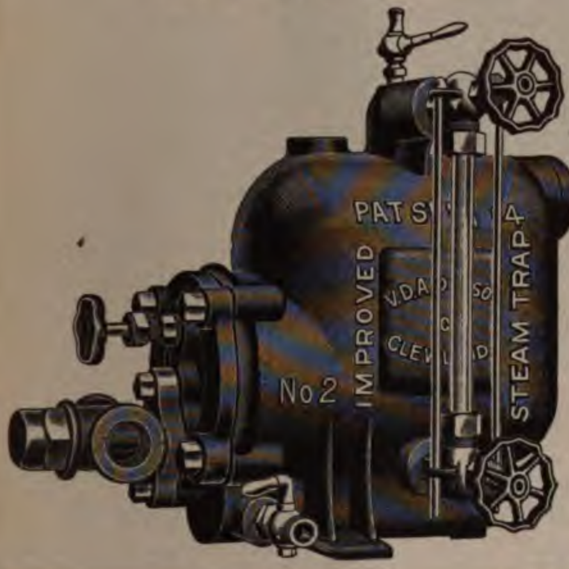
The Standard Steam Trap of America
IS THE

ANDERSON

MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.



This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

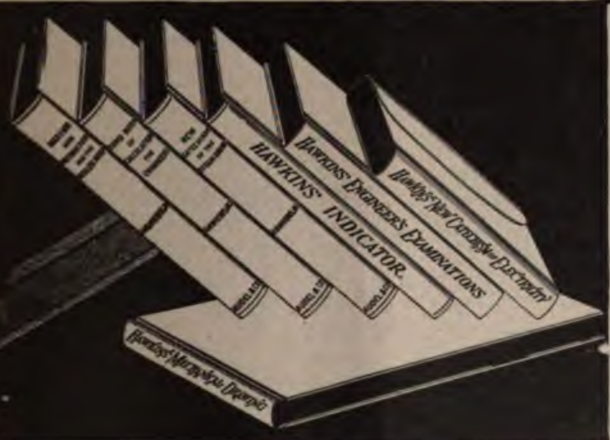
Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

HAWKINS' ENGINEERS' LIBRARY


HAWKINS' INDICATOR
Hawkins' Engineers' Examinations
Hawkins' New Catechism of Electricity
Hawkins' Mechanical Drawing

LIST

1.	Hawkins' Self-Help Mechanical Drawing, - -	$2
2.	Hawkins' New Catechism of Electricity, - - -	$2
3.	Hawkins' Aids to Engineers' Examinations, - - (With Questions and Answers)	$2
4.	Hawkins' Maxims and Instructions for the Boiler Room,	$2
5.	Hawkins' Hand Book of Calculations for Engineers, -	$2
6.	Hawkins' New Catechism of the Steam Engine, - -	$2
7.	Hawkins' Indicator Catechism (a Practical Treatise)	$1

NOTE:—When set is purchased, the seven volumes are supplied for $12.00, being a reduction of $1.00 from above list.

Send for Hawkins' Catalog. **Note Monthly Payment Plan.**

To Readers of Engineers' Review:

In again asking the attention of the Mechanical World to the Hawkins' Engineers' Library and the "little at a time" payment plan on which these books are supplied, the publishers wish to express their appreciation of the hearty support and endorsement tendered by those who have been and continue to be students of engineering.

The works are kept constantly "up to the times" by frequent revisions and additions by the author; to this fact is undoubtedly due their continued popularity.

$1 MONTHLY PAYMENTS

The books are sold on easy payments; the set, seven volumes, price $12.00, will be sent, express prepaid, to any address on receipt of $1.00, and agreement to pay balance in monthly installments of $1.00. Each volume is complete in itself; one, two, three, four or five books of the series will be sent on the same easy terms, that is, one dollar with order and remainder of the purchase money $1.00 monthly.

CUT OUT AND MAIL, TODAY

I accept your offer to supply me with HAWKINS' ENGINEERS' LIBRARY (seven volumes) for $12. Enclosed find $1 as first payment; the balance I agree to remit in $1 monthly installments.

Name..*Occupation*..

Address..

You are at liberty to consult the Person named below as to my reputation for keeping business promises.

Name..

Address..

ENG. REV.

THEO. AUDEL & COMPANY,
Publishers,
63 Fifth Avenue, NEW YORK CITY.

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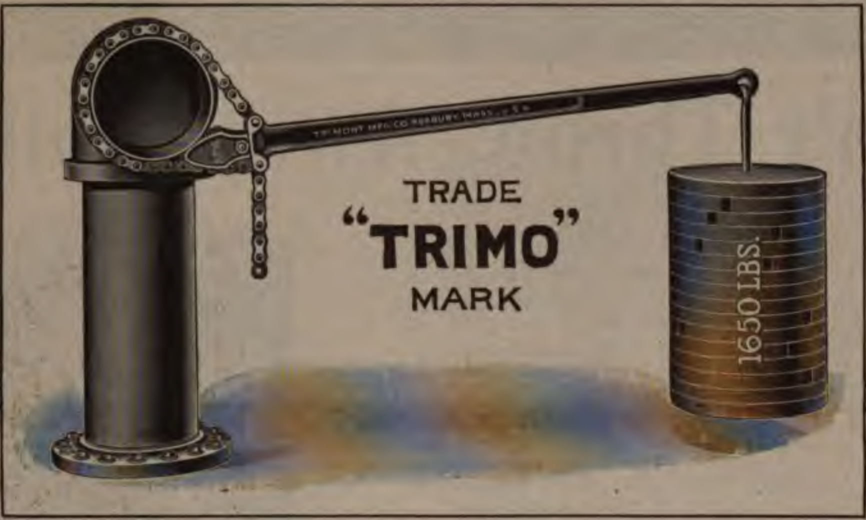

Cut made from photo of Trimo Bulldog No. 16, in our St. Louis Exhibit

This Tells the Story

What other chain wrench could support a weight of 1650 lbs. hung from end of handle for six months, *without slipping or buckling?* Such a test furnishes pretty convincing reasons why you should

TRY THE TRIMO

Note how the chain is attached, causing the greatest strain to come on the *handle*, not on the jaws. This feature makes the Trimo Bulldog the strongest chain wrench on the market. Both jaws and handle are drop-forged steel, and the chain thoroughly tested.

There are several other good points. Shall we send our catalog?

TRIMONT MANUFACTURING CO. **Roxbury, Mass.**

IN THE ENGINE ROOM
EQUIPPED WITH

The White Star Continuous Oiling System

There is no waste of oil; waste of time; waste of waste; oil-soaked floors; or bearings running hot.

But one handling of oil—from barrel to system. Booklet "J" tells you all about it.

Pittsburgh Gage and Supply Co.
PITTSBURG, PA.
and 415 John Hancock Bldg., Boston, Mass.

Eastern Representatives:
VANDYCK-CHURCHILL CO.
8 Dey Street, New York. The Bourse, Philadelphia.

OIL FILTRATION EXPERTS.

An Acme Oil Filter

How could we afford to make this offer if an **ACME OIL FILTER** did not live up to it?

We will send an **ACME OIL FILTER** on

30 DAYS TRIAL

and will agree to take it back, paying carriage both ways, if, at the end of that time it does not filter and reclaim more waste oil, in less time than any other filtering device of the same capacity made. What could be more fair?

WALTER L. FLOWER & CO.,
1011 Chemical Building,
ST. LOUIS, MO.

Don't Throw Away Dollars

The used lubricating oil which you have been throwing away or allowing to waste in the drip pans is worth money to you if you have a

Cross Oil Filter

at hand. Guaranteed to save one-half your oil expenditure and afford oil as good as new. Send for Filter today on 30 days' trial to test our guarantee.

March 26, 1903.

BURT MFG. CO., Akron, Ohio.

GENTLEMEN:—Replying to your favor of the 24th inst., we now have in use three of the No. 4 Filters, and the writer has had further experience with them in the past. So far as we are aware, they are the most satisfactory Oil Filter on the market and we have no complaint to make relative to their operation.

Yours respectfully,
ST. LOUIS PORTLAND CEMENT CO.
Per JOHN C. ROBINSON, Sec.

PROTECT YOUR ROOFS

Why suffer the annoyance of damp, filthy, greasy, decaying roofs caused by spraying exhaust, and then in the end spend the money for roof repairs.

The Burt Exhaust Head

will eliminate the difficulty. It has proven it's value to thousands of plants, and will do efficient work for a long time. Sent anywhere on thirty days' trial at our expense.

GLEN RIDGE, N. J., Oceober 22, 1903.

THE BURT MFG. CO., Akron, Ohio.

GENTLEMEN:—The Burt Exhaust Head which we have had in use for about five months serves its purpose admirably, and is giving entire satisfaction.

Yours truly,
EDISON STORAGE BATTERY CO.,
REYNOLD JANNEY, Manager.

THE BURT MANUFACTURING CO.

Largest Manufacturers of Oil Filters in the World,
228 Main Street,
AKRON, OHIO, U. S. A.

Also Supplied by Oil Companies, Dealers and Power Contractors.

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ider-Hughes Co.

r Compressors, Gasoline
lumbus Machine Co.

larms, High and Low Water
ane Co.
nkenheimer Co.
nberthy Injector Co.
tsburg Gage & Supply Co.
liance Gauge Column Co.
ight Mfg. Co.

ch Plates, Boiler
mprey Co.

tomobile Fittings
nkenheimer Co.

lt Dressing and Filling
ng-Surface Co.
con Crucible Co., Jos.

lting
rpenter & Co., Geo. B.
icago Rawhide Mfg. Co.
ance Packing Co.
aker City Rubber Co.

owers
ys, Chas. N.
io Blower Co.
ider-Hughes Co.

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iler Feeders
vis Regulator Co., G. M.

ilers
tman & Taylor Mch. Co.
oper Co., C. & G.
rrison Safety Boiler Works.
ys. Chas. N.
lyoke Steam Boiler Works.

Boiler Tube Cleaners, Mechanical
Gem Mfg. Co.
General Specialty Co.
Hubbard & Co.
Lagonda Mfg. Co.
Liberty Mfg. Co.
Maurer, Labadie & Co.
Pierce Co., Wm. B.

Books
Audel & Co., Theo.
Engineers' Review Co.
Tulley & Co., Henry C.
Van Nostrand Co., D.

Boring Machines, Electric
McCrea & Co., Jas.

Brass Founders
Williams Valve Co., D. T.

Burners, Gas
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Carpenter & Co., Geo. B.

Chemicals
Lord Co., Geo. W.

Clamps, Pipe
McCrea & Co., Jas.

Clamps, Steam Joint
McCrea & Co., Jas.

Cocks
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Cocks, Gas
Pittsburg Gage & Supply Co.

Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.

Commutator Lubricants, Graphite
Dixon Crucible Co., Jos.

Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.

Compounds, Car Axle
Lubron Mfg. Co.

Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.

Compounds, Lubricating
Keystone Lubricating Co.

Condensers
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Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Counter Shafts
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Cutters, Gasket and Washer
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Cutters, Tube
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Myers & Bro., F. E.

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Myers & Bro., F. E.

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Dust Collectors
Ohio Blower Co.

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Chicago Injector Co.
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Penberthy Injector Co.

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Emery Wheels
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Buckeye Engine Co.

Engines, Gas and Gasoline
Buckeye Engine Co.
Columbus Machine Co.
Marinette Gas Engine Co.

Engines, Gasoline Hoisting
Columbus Machine Co.

Engines, Steam
Bates Machine Co.
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Cooper Co., C. & G.
Ohio Blower Co.
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Reeves Engine Co.
Russell Engine Co.

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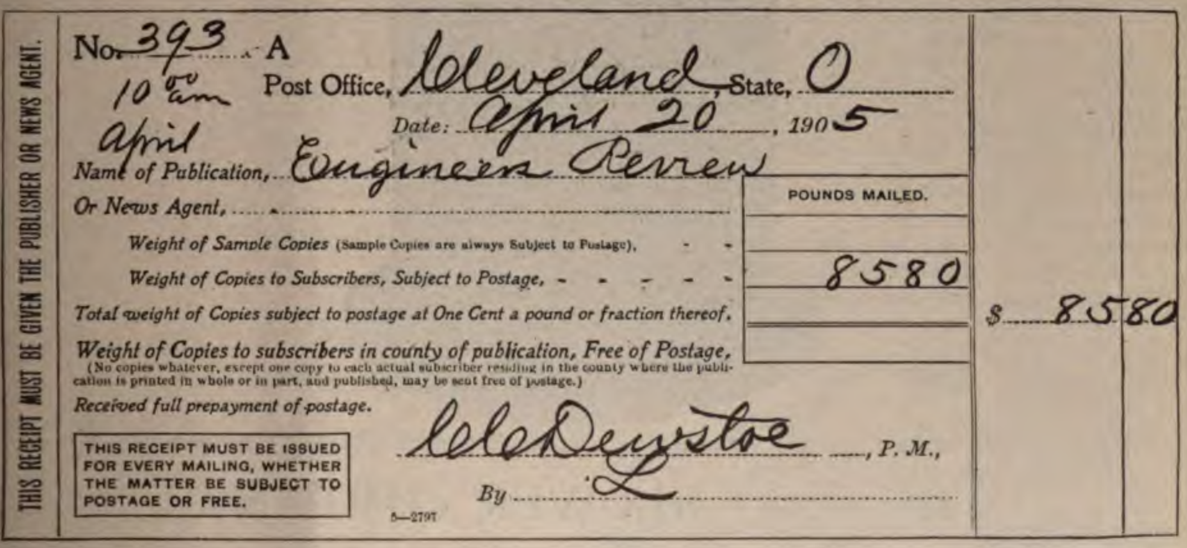
Wright Mfg. Co.

(Continued on Page 65.)

ABSOLUTE PROOF.

Below is a fac-simile of the Post Office receipt, showing the actual number of pounds of Engineers' Reviews mailed for April. Under the cut is complete explanation.



THIS RECEIPT MUST BE GIVEN THE PUBLISHER OR NEWS AGENT.

No. 393 A

10^{00} am

Post Office, Cleveland, State, O

Date: April 20, 1905

April

Name of Publication, Engineers Review

Or News Agent,

	POUNDS MAILED.	
Weight of Sample Copies (Sample Copies are always Subject to Postage),		
Weight of Copies to Subscribers, Subject to Postage,	8580	
Total weight of Copies subject to postage at One Cent a pound or fraction thereof.		$ 85.80
Weight of Copies to subscribers in county of publication, Free of Postage, (No copies whatever, except one copy to each actual subscriber residing in the county where the publication is printed in whole or in part, and published, may be sent free of postage.)		

Received full prepayment of postage.

, *P. M.*,

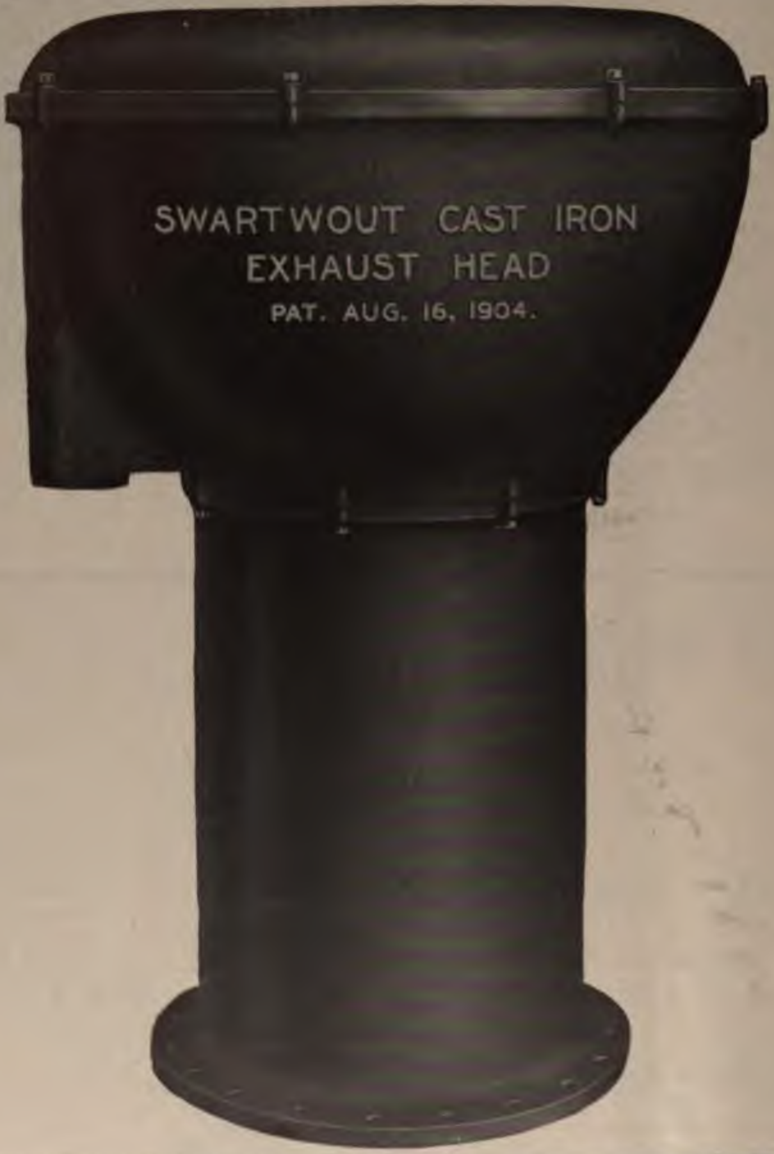
By

THIS RECEIPT MUST BE ISSUED FOR EVERY MAILING, WHETHER THE MATTER BE SUBJECT TO POSTAGE OR FREE.

5—2797

Total number of pounds for April issue	8,580 pounds
Deducting wrapping paper	140 "
	8,440 pounds
One copy of April issue weighs 6¾ ounces, making a total number, mailed at pound rate, of	20,006 copies
Copies mailed in Cleveland under stamps 275, and 319 delivered to our office make an addition of	594 "
The total edition for April being	20,600 copies

THIS CUT is made from a Photograph of a 20-Inch Swartwout Cast Iron Exhaust Head, furnished to Merchants Heat and Light Company, Indianapolis, Ind. We also make Swartwout Combination Cast and Galvanized Exhaust Heads and Steam Separators.



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SOLE MANUFACTURERS,

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Sales Agents for Wm. Bayley & Sons Company, Milwaukee, Wis., Manufacturers of Hot Blast Heating Apparatus, Blowers, Engines, Dry Kilns, etc.

ontinued from page 63.)

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Practical
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300
Now in Use
"We cheerfully recommend your preventive to anyone needing anything in this line."
Peerless Motor Car Co.
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This device is so simple that a child can operate it. The price is moderate.

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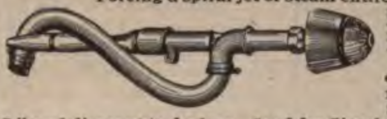
Forcing a spiral jet of steam entire length of tube.



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There's no guess work about Lord's Boiler Compounds.

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Number of boilers in use ________________
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Continued from page 65.)

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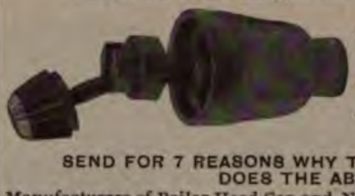
Takes the Scale off QUICK inside and outside.



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To do the work in less time.
To cost least to keep it in repair.
To save ⅗ your water bill for cleaning.
To operate successfully by air, steam or water.
SEND FOR 7 REASONS WHY THE "LIGHTNING" DOES THE ABOVE.
Manufacturers of Boiler Head Cap and Nut Reseater and Cleaner, Perfect Expansion Flue Brush and X-Ray Oil Filter, etc.
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THE KNOX WATER TUBE CLEANER
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Convenient, Reliable, Effectual, Economical.

Has steel cutters revolving diagonally on anti-friction bearings. Used in straight or bent tubes with entirely satisfactory results. No special fitting-up required. Write for particulars.
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A Cleaner With Good Points Sticking Out All Over It.

That's the Cleaner Shown Above.
HAVE YOU TRIED ONE? WHY NOT?
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The "Liberty" Boiler Tube Cleaner

Is the result of years experience. It is the standard of excellence. It never fails to clean tubes in a thorough manner, regardless of the thickness of scale. Even if the tubes are filled up solid the "Liberty" cleans them quicker than a heavy and expensive power machine. There is no other boiler cleaner in the "Liberty" class; it stands alone in efficiency and durability.

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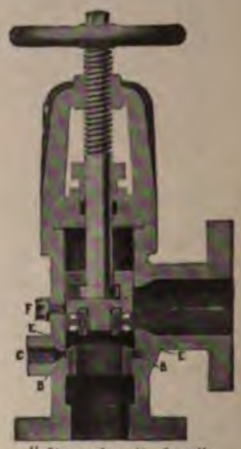
Is designed for high pressure service. It is extra heavy and well made. A trial order will convince you as to its merits. You will find by using the "Faber" that your blow-off valve troubles are settled, and have passed into history.

A steam jet prevents the scale from damaging the seat and disc.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WEINLAND INSTRUMENTS
FOR "BOILER SURGERY"

The worst cases of scale can be operated upon successfully with

WEINLAND TUBE CLEANERS

Water drives the machine and a steady grinding process cuts the scale from the iron without expanding, loosening or injuring the tubes in any way. They have restored thousands of boilers to perfect condition, and what they have done for others they'll do for you. This cut shows our No. 8—THE KING OF TURBINE CLEANERS, besides which we manufacture others—Hand Cleaners and Power-Driven Cleaners—all kinds and sizes for all styles of boilers and all sizes of tubes. "No tube cleaner Like a WEINLAND"—Anybody who's used one will tell you that. We do contract cleaning if you want it that way.

For "AMPUTATING" Tubes use THE LAGONDA TUBE CUTTER

Cuts at any point of the tube.

It does the work quickly, easily, and cuts clean every time—leaves no burr. Does not bend or mar the tube in any way. A simple, inexpensive tool needed in every boiler room.

For "CONSUMPTION" of Coal use The Lagonda Damper Regulator.

It absolutely controls damper in stack on the slightest variation of steam.
Get Catalogue of the above and Steam Specialties.

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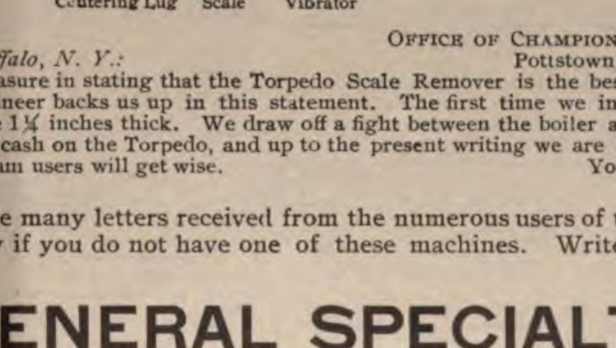

OFFICE OF CHAMPION SILK CO.,
Pottstown, Pa., March 27, 1905.

The General Specialty Co., Buffalo, N. Y.:

GENTLEMEN—We take pleasure in stating that the Torpedo Scale Remover is the best proposition that ever came into our boiler house. Our engineer backs us up in this statement. The first time we introduced the Torpedo to the boiler flues, it knocked off scale 1¼ inches thick. We draw off a fight between the boiler and the Torpedo about every four months. We bank all our cash on the Torpedo, and up to the present writing we are a great many dollars to the good. We trust that other steam users will get wise.

Yours truly,
CHAMPION SILK CO.

The above is one of the many letters received from the numerous users of the "TORPEDO." You are losing money every day if you do not have one of these machines. Write today. It will be sent on free trial.

THE GENERAL SPECIALTY CO.

73 Carroll Street, BUFFALO, N. Y.

Here, Mr. Engineer, We'd Like to Have a Talk With You.

Do You Want to Increase Your Salary?

We rather think you do.

Here is a plan which if you follow out, will surely result in some increase if you handle the matter right.

We believe that you are burning more coal than necessary.

Why?

We know you have scale on your boiler tubes, unlss you are the one plant in a hundred which doesn't have it, or you are using the Dean Boiler Tube Cleaner.

Now don't you think if you can save several hundred dollars a year in fuel that your employer will share a little of it with you?

Try it and see.

It won't cost you anything to make the test.

Here's the plan:

We've a little pamphlet called "Boiler Room Economy."

Send for it today.

Read it carefully.

It will tell you a lot of things about boiler scale.

It will tell you the only way in which this scale can be permanently eradicated.

And that is by frequent uses of the Dean Boiler Tube Cleaner.

The pamphlet also tells about our trial offer whereby we will loan you a cleaner for trial in one of your boilers.

Its use will show the tremendous scale in your boilers, the excessive firing which you have had to give it, and the tremendous loss in fuel which has been going on.

While the trial is on, have your employer down in the boiler room to see what waste has been going on—not through any fault of yours, but through scale.

If you handle the matter right, you ought to get a part of the subsequent fuel saving.

Here is an illustration of the Dean Boiler Tube Cleaner working in the tube of a return Tubular Boiler:

Here is an illustration of the same cleaner working in the tubes of a water tube boiler, the only difference being in the hammer head:

You will readily appreciate the use of this cleaner once you see the little machine.

With compressed air or steam behind it at a pressure of from 50 to 70 pounds, the little hammer head taps the tube from 3500 to 4000 times a minute.

It can't hit hard, for the tube is so small and it goes so fast.

It can't possibly damage a tube.

But it will show up any pitted or burnt out tubes, and this you ought to be glad to know before any accident should happen.

After an accident you probably wouldn't know what caused it, but the chances are 10 to 1 that it would have been a pitted tube which scale was holding in place.

Don't pass this matter idly by.

It's important to you, for if handled right, you'll get an increase in your salary.

Now is the time to write for "Boiler Room Economy."

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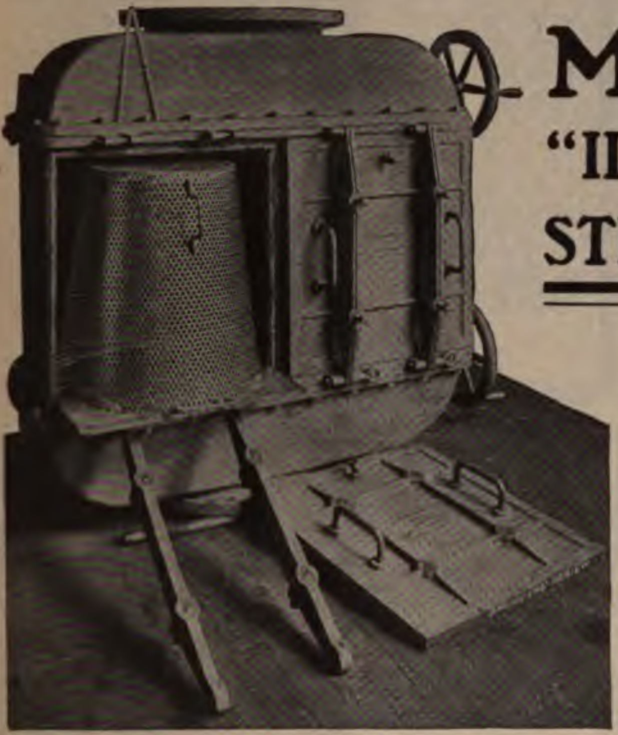
The Highest Economy Obtainable

in plants running condensing, cannot be obtained without some sort of strainer for catching the refuse in the water used for condensing. It is important that such a strainer be so constructed that it can be easily and quickly cleaned without interrupting the flow of water or injuring the vacuum.



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is designed especially for such conditions and is used in many plants where both steam turbines and reciprocating engines are employed. It is just the thing for feed and fin pump suctions, or any water main in which there is floating refuse or debris, such as leaves, sticks or eels, &c. Built in sizes from 2 to 24 inches. Further information gladly furnished. Sent on trial to responsible parties.

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30 DAYS' TRIAL
TO PROVE OUR CLAIMS

Ruggles Perfection Flue Cleaner

will quickly prove its worth in any plant.

It is the simplest cleaner on the market—being made of two parts.

No screws or rivets used in its construction. Sharpens itself. Absolutely cleans the flue. It is strong and reliable.

Send for one on trial.

RUGGLES & RUGGLES,
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PALMETTO TWIST PACKING.

Forty Yards to a Pound Spool.
Good Value, and Full Valve.

How long would it take you to dope out forty yards of Asbestos wick; and even then forty yards of Asbestos wick would never do the work of half the quantity of Palmetto Twist Packing.

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under any condition likely to be imposed, always remains soft, pliable, and well lubricated.

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If he is an engineer tell him that we have a special offer to make him.

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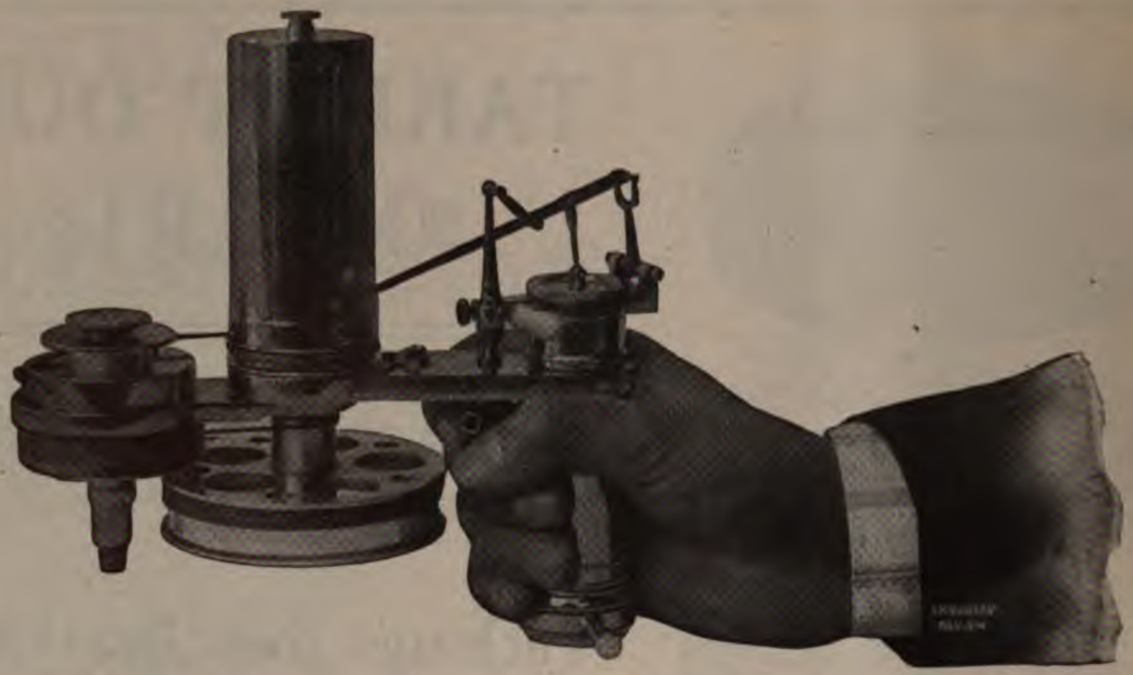

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tells at once whatever trouble may exist with the engine, and points the way for the engineer to correct the trouble. More than this, a Robertson-Thompson Indicator points the way to more money and a better position for any engineer. We sell them to engineers on easy terms.

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gives an absolute perfect reduction without any lost motion whatever. Can be instantly connected or disconnected while the engine is in motion.

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on the main steam line will prevent water from entering into the cylinder; in the exhaust line it will keep oil from the boiler. Cost is nominal.

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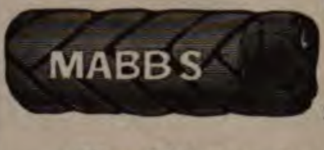

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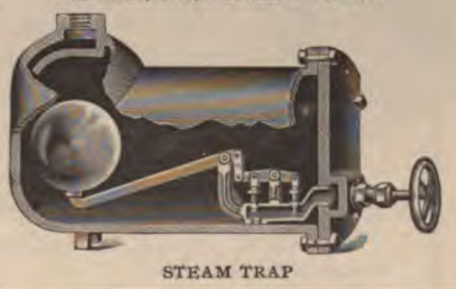

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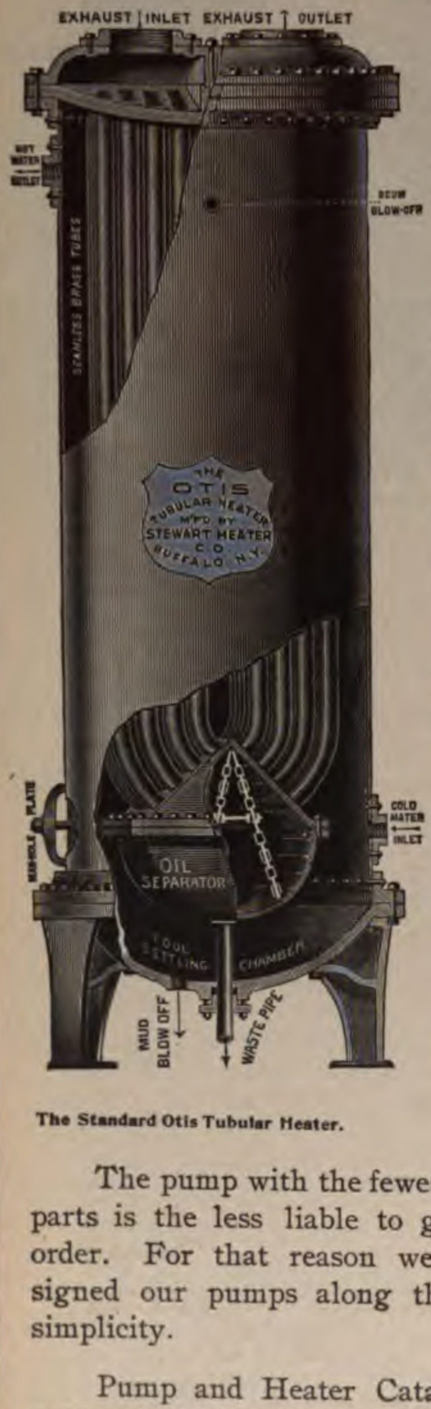

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A feed water heater will put the water into your boilers at boiling point, thus reducing the amount of fuel used. A good heater should pay for itself in a short time.

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While these pumps are of the double plunger type, they can be run as double pumps or as two distinct single pumps.

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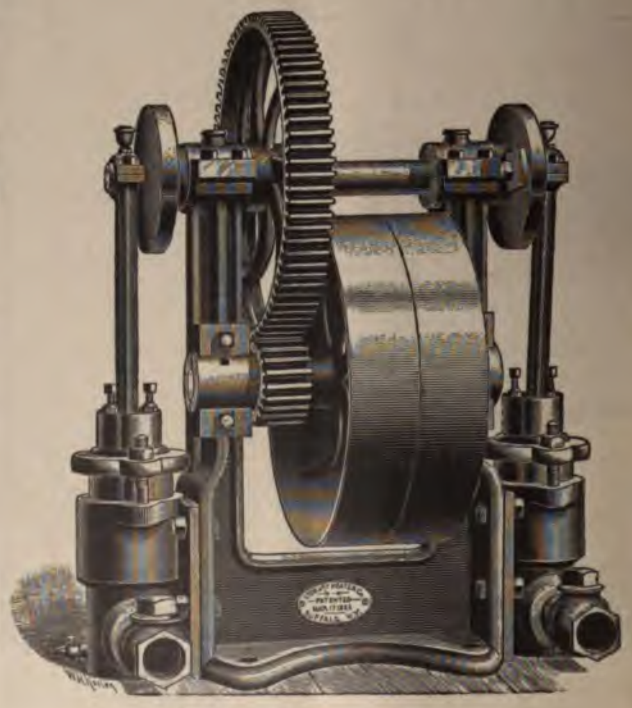

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First: SIMPLICITY in a machine means doing the work in the st direct manner with the least number and least complicated parts. MONITOR scores on all three points, because the steam valve for cylinder is operated directly by the steam piston in the opposite linder, whereas in the old style duplex pump the steam valves are rated through a system of levers consisting of over twenty small more or less complicated pieces.

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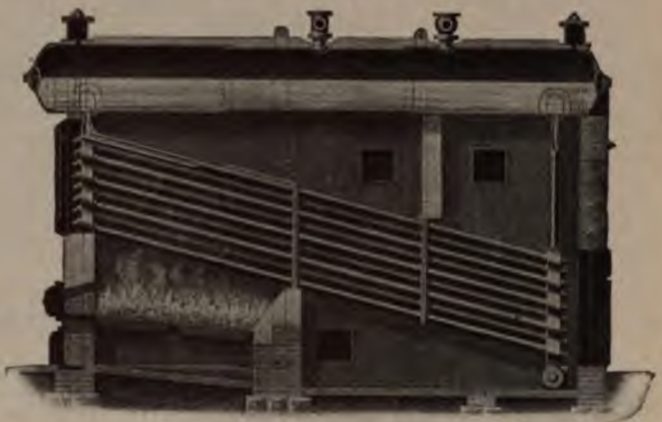

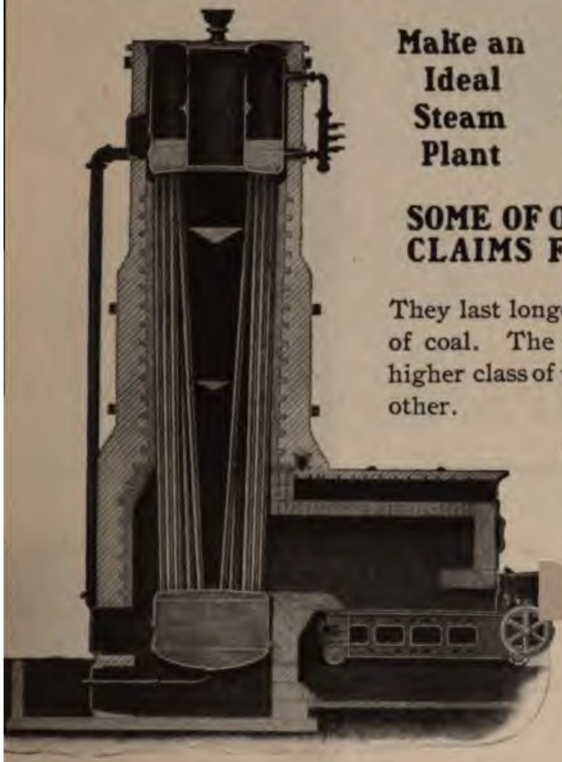

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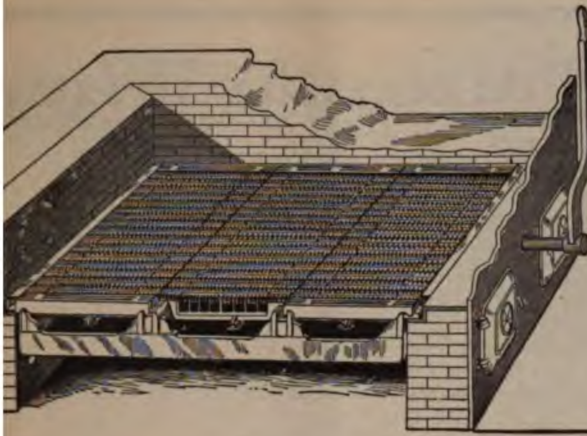

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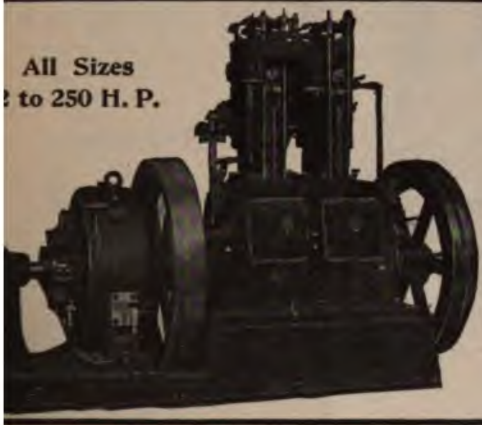

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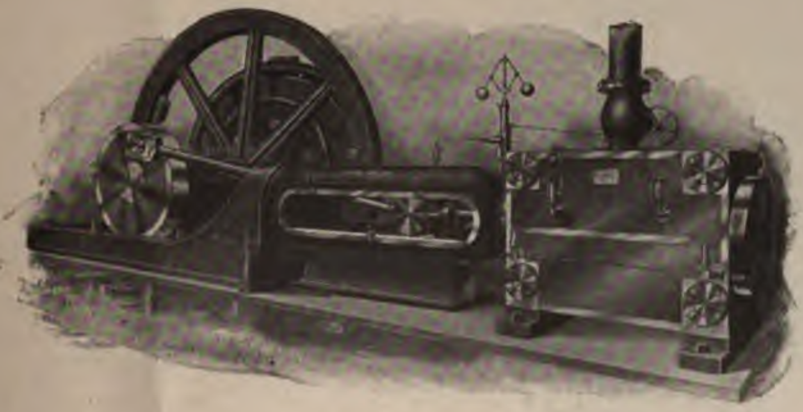

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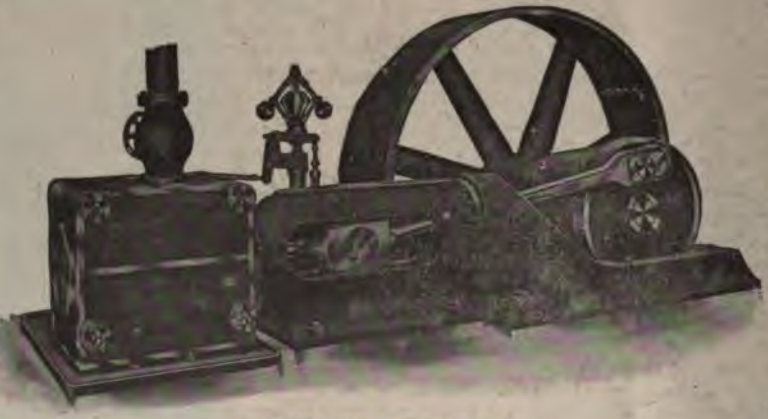

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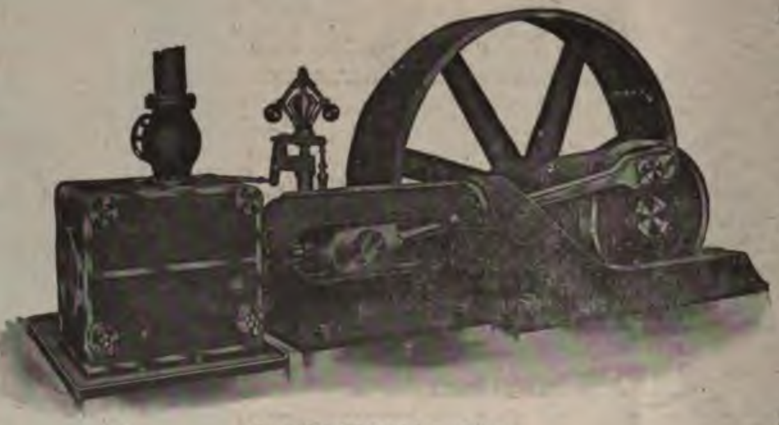

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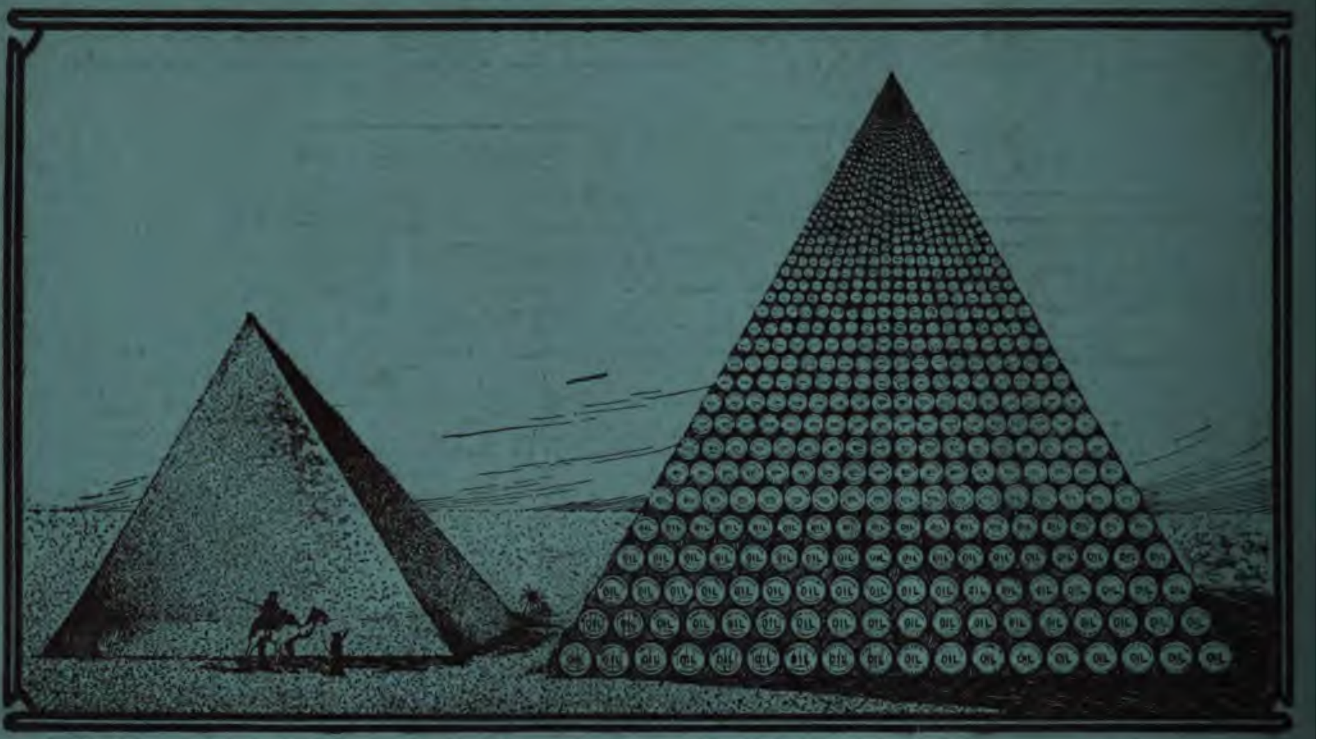

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ENGINEERS' REVIEW

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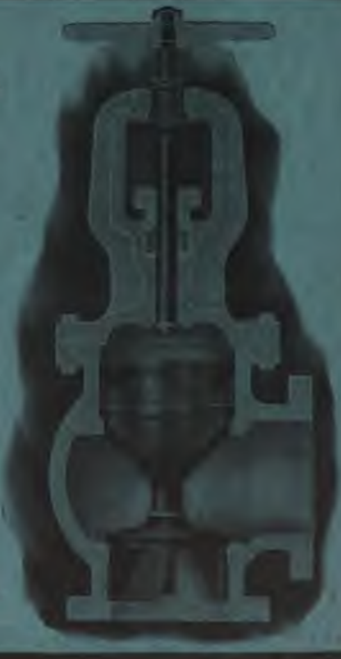

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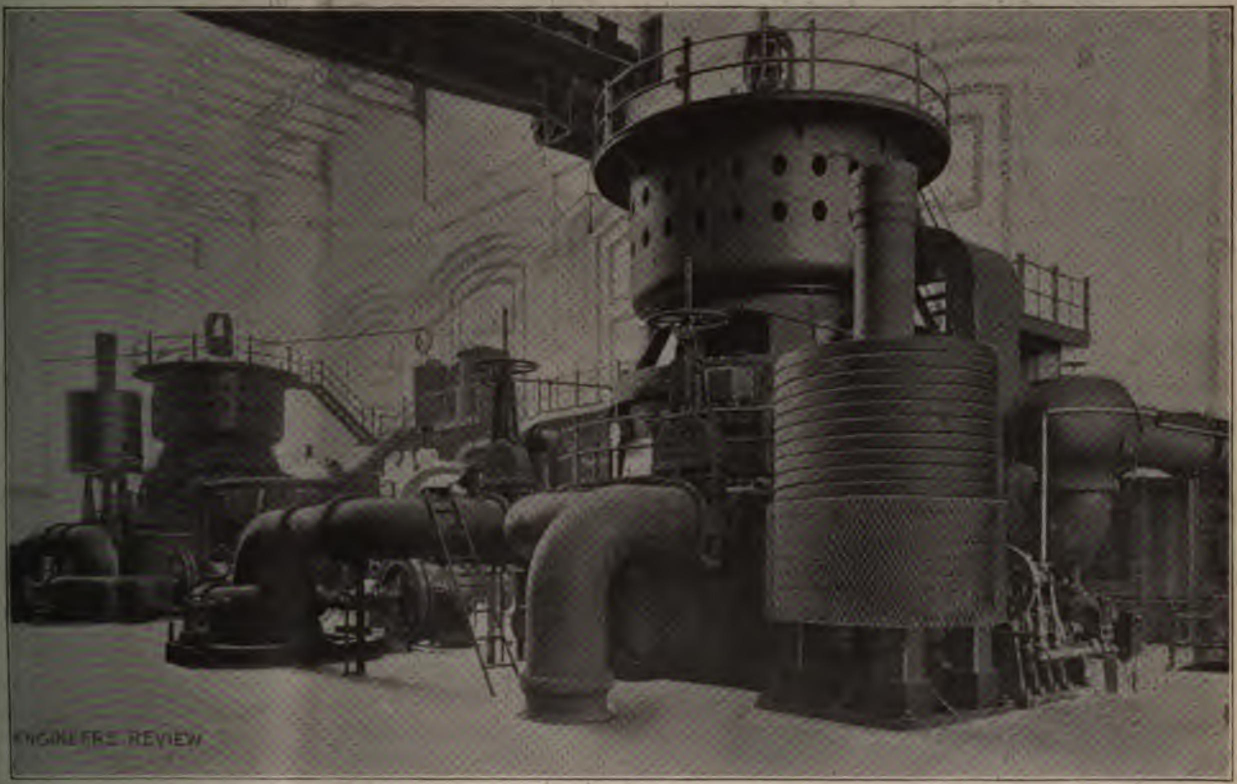
ENGINEERS' REVIEW
FOR STATIONARY ENGINEERS
VOL. 16. CLEVELAND, JUNE, 1905. No. 4.

THE BOSTON EDISON TURBO-GENERATOR STATION.

The location and design of the central station of the Edison Electric Illuminating Co. of Boston is ideal in many respects. Situated on L street, So. Boston, the fuel can be brought to it at a minimum of expense for freight and handling, as it has a water front of 815 feet, only 1½ miles from the main ship channel of Boston harbor. The docking facilities are ample for coal carrying vessels of from 7,000 to 8,000 tons burden.

The new station has been planned for an ultimate capacity of 60,000 kilowatts. The first installation consisted of two 5,000-kilowatt, 6,000-volt, 60-cycle alternating current generators and Curtis turbines. These turbines are mounted upon specially designed surface condensers which form the base of the turbine structure. The first unit has been in commercial service since October and the second unit since November, 1904. The turbine room will be 650 feet long, 68 feet wide and 56½ high, there being no basement. The reason for spreading the power house over such a large area, is that the value of real estate is very low in this section and it was cheaper to do that than to build additional stories for the sake of saving ground area.



CURTIS TURBINES AND GENERAL ELECTRIC GENERATORS OF THE EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON, MASS.

The boiler house will be 640 feet long, 149½ feet wide and 56½ feet high. The switch house will be 605 feet long, 30 feet wide and several stories high.

Special care has been taken to so group the apparatus that each piece will come under the charge of the operator best fitted to care for it. For instance the turbine room contains all the machinery in the station, even down to the boiler feed pumps, which are usually considered as belonging to the boiler house. In this instance they are treated as auxiliaries to the turbine. The boiler house contains only boilers and the necessary piping. The electrical apparatus has been grouped in the same way and installed in a separate building adjoining the turbine room. This is a feature of considerable merit, as the electrical apparatus is away from the noise and dirt of the turbine room. It also eliminates such damage as could be brought about by accident to the turbine machinery, and permits the operator to do his work under favorable conditions without being disturbed by matters outside of his own domain.

All apparatus is installed on the unit system, *i.e.,* the auxiliaries for each generating set are grouped together around that unit in the turbine room, and are of sufficient capacity to serve that unit alone. The boilers necessary to supply it are situated directly behind the turbine, making each generating unit a small central station in itself. The units are connected in pairs and there are practically no cross connections except those between each pair. As the steam mains are joined by a small sized tie line, a generating unit can be run temporarily from the boilers of its mate if necessary. This very simple system of piping is sufficient for the requirements and at the same time reduces the first cost as well as maintenance. The plant is different from others, insomuch that the duplication of auxiliaries is eliminated, and if a generating unit is put out of commission for any cause, it is intended that the entire unit be shut down, and another started in its place.

In determining the apparatus to be installed in this station, the respective merits of a turbine and steam engine as prime movers were given thoughtful consideration, and the turbine chosen. This was because of the advantage of the turbine over the engine in first cost, the less amount of labor required to operate it, the ability to use condensed steam with safety in the feedwater, and the fact that it takes up so much less room. The water constumption of the turbine in comparison with that of the reciprocating engine was not considered. Another important feature of the turbine is the ability to start an idle unit quickly.

The Curtis turbines used in this plant have a rated capacity of 5,000 kilowatts, being of the four stage type. The stages correspond to the various cylinders of a quadruple expansion reciprocating engine. Each has a surface condenser built in its base, and is equipped with a mechanical brake for bringing it to rest in case of an emergency. The turbines in this plants are the first ones to possess these features.

The condenser was located in the base in order to obtain a better vacuum in the turbine, which is a most important factor in turbine work. At the same time it reduces the floor space required for the installation, and simplifies the piping somewhat. The brake is considered a very useful addition in case it is desired to shut down quickly, because a turbine will run for some time with no load and no field excitation. The brake also facilitates the overhauling of the step bearing by sustaining the weight of the rotating parts.

The auxiliaries for each turbine are as follows: A circulating pump driven by a Harrisburg engine, a jet and dry vacuum pump, a Worthington steam boiler feed pump for the group of boilers connected to that particular turbine and a hydraulic accumulator. These auxiliaries are steam driven with the exception of the wet vacuum pump which is operated by means of a motor, because the speed is too high to be conveniently handled by an engine. The designers of this plant considered steam more economical as an auxiliary drive than electricity. The exhaust from all the auxiliaries is carried to the feedwater heater, and is condensed in heating the boiler feedwater, and afterward discharged to the sewer as it contains too much cylinder oil to attempt to purify it. By using the exhaust for this purpose the greatest possible amount of heat originally put into the water in the boiler is taken out. It is also estimated that the first cost of steam driven auxiliaries is less than electric drives
and that there is a greater speed regulation ov
ranges than there would be with motors. The
ugal pump used in circulating the water is
by a high speed engine. As the quantity of wat
handled is very great and the head very low,
trifugal pump is well adapted for this purpose.
using a centrifugal pump a much smaller ma
required as compared with a piston pump, it
less expensive, and being simple requires alr
attention. A distinct advantage of the dry
pump is that the air cylinder is placed in a rig
to the steam cylinder. This gives a better
moment to the crank. The air end is buil
stage and will maintain a vacuum on a
tank to within ½ inch of absolute. A governo
steam end permits of a speed variation while
The wet vacuum pump consists of a two-sta
trifugal pump, and is motor driven. It wil
tain a vacuum in the condenser equal to tha
dry vacuum pump, without the use of either
or discharge valves. The boiler feed pum
ordinary duplex, center packed plunger pum
cooling water is conveyed to the pump by brick
which run under the center of the turbine
such a grade that they are always flooded. I
to insure a water supply at all times, two tun
provided, each supplying one-half the station.

The boilers are placed in pairs alternately
face and back to back with a chimney for e
midway of the row and between them. Six c
are required, each being 230 feet high above t
of the grates which makes it possible to dispe
forced draft. The boilers are elevated ab
ground in order to provide sufficient space
for the handling of ash, which is discharged
valves in the bottom of the chambers, into
the ground floor. A portion of the basemen
the two rows of boilers is separated from
room by a partition, forming a pipe room i
are located the various pipe mains which conn
the boilers. Branch pipes only are taken
fire room. This puts most of the boiler roo
in a room by itself where it is easy of acces
comparatively free from cold draft. Each
boilers is supplied with coal by bunkers built
tors above the roof. As there is practically n
on top of the boilers, little space is needed abo
and the building of the coal bunkers and
enables the boiler house to be made very low a
considerable in the cost of the building.

The total number of boilers to be installe
having a rated capacity of 500 horsepower each
are of the Babcock & Wilcox type, equipp
superheater coils, and Roney stokers. They
for a working pressure of 225 pounds of st
square inch. A pressure of only 175 pou
square inch is used at the present time. The
are higher by two rows of tubes than is t
practice. This provides for additional storag
water and also serves as additional heating
Steam is superheated 150 degrees, and it is
that it will not cause trouble with flange joint
steam cylinders of the auxiliaries. Economiz
not installed, because of their doubtful valu
the operating conditions of this station, and
effect on the chimney draught. This would
to cause a reduction in the capacity of the pl

/hen the maximum was required, or else make ·ssary to cut the economizer out of commission ı time when it would be most needed.

freight rates in Boston are sometimes 75 cents higher in winter than in summer, therefore the e of coal is a very essential feature. Alongside ıtion and adjacent to the water front has been ed an open air storage, capable of holding from to 70,000 tons of coal. The winter supply can :chased during the summer while the rates are To unload the coal from the vessel at the and to convey it to the station or storage yard, plete system has been designed which consists electric tower operating a 1-ton clam shell : and an electric hydraulic tower operating a r bucket of 1½ tons. The coal is conveyed from ıarf to the storage yard by belt conveyers, hav- maximum capacity of 700 tons of coal per hour. h generator is a 3-phase alternator, Y connected, le machine generating 690 volts, and operated ırbine speed of 514 revolutions per minute. The oltage was used in this instance because it is a le of the voltage of the old station and from the hat the bulk of the alternating current is used hting. The engine driven alternators generating oo volts makes it possible for both stations to on the same load through transformers. The ɔars of each system are installed in duplicate ɔ arranged that they can be cut into short sec- of no more than 10,000 kilowatts each, by tie- es, and any transmission line or generator can lated if it is desired. The switches are all in- on the third floor of the switch house, the switches being installed in two single rows, ı each side of the switch house and against the /all.

generators are connected to the buss bars ;h one main switch and two selector switches. switches are designed to open under full station ty should an emergency ever demand it. Se- switches have been placed on the transmission but no main switches have been provided. The ıission lines and also the turbine leads and ormer leads enter the basement of the switch in duct lines, terminating nearly underneath the ɪr switches, with which they connect. The elec- operating room is on the top floor of the switch at about the center of the building and contains ıg but the operating apparatus. A signal sys- nables the operator to communicate his orders of the generating rooms. The system also pro- for acknowledging the order and indicating when been carried out. A small steam engine drives the r set, which is of sufficient capacity to start an : driven alternator should the entire station be lown. Three small motor driven alternators are d in the old engine room, having a capacity suf- for all the engine driven alternators. There so three large motor driven exciter sets, one in ɔf the individual turbine rooms with sufficient ty to supply the turbines. In addition to the generators, there is a storage battery with a ty of 1,000 amperes for an hour located on the tion buss bar.

: aim of the engineers in constructing the plant een that of simplicity and reliability and ex- :nting and untried devices have been avoided. The main thing has been to install apparatus which would operate at a minimum cost for labor and repairs, and also operate continuously.

ENGINE ROOM CHATS NO. 19.

BY A. GOVERNOR.

"Wall, bedad; this is sumthin' loike livin' afther th' could winter we've afther been havin'!" was the comment of Dan Googan as he gazed out of the fireroom door and watched the rain falling in torrents, such as only comes with the advancement of spring. "Ther first thing we'll be doin' will be ter sit out in ther sunshoine and be glad we do be livin'. Oi can't help but be thinkin', as ther hot days come on, thot it'd be moighty foine if we could only make steam wid a gas engin', fur if there's wan thing as brakes me heart, 'tis clanin' foires whin ther thermometer is jugglin' wid the 90 mark."

"Don't you go to wishing too hard for a gas engine, or you may be looking for another position," said Sam, as Dan wiped the sweat from his brow. "The gas engine is taking the place of a good many steam engines, and the fireman has had to find something else to do, and that might be your case if we should put them in here!"

"Bedad! Oi'm not botherin' me head about luckin' fur another place! Sure Oi've enough sinse ter know that ther company won't put in any more dollars into engines until they've got some out of thim they have just put in. Me sicond cousin Tim Murphy has a job runnin' a gas engin' and ther snap he has bates ther divil. He jists shtarts ther thing up, and afther it gits ter coughin' jist roight he sits down and takes things aisy, whoile Oi'm shovelin' coal and workin' ter bate ther band."

"Gas engines vos no goot, und I don'd like um; der noise dey makes vos enough to make a man nervous mid prostration, py chiminy," exclaimed Fritz.

"I remember when the gas engine first came out what little jack-of-all traps they were," began Pete Haynes. "They were not the same as the gas engines we have around nowadays; about the only thing they were good for was to put on some little insignificant job such as wood saws and pumping water.

"They lacked value sufficient for important work then, but the way they have gone ahead and got into favor is shown by the way in which they have worked into the largest power stations. When the gas engine came first it wasn't much more than a rattletrap at best and was made up of a good many parts which were always getting out of kilter."

"How long have gas engines been fur sale, anyhow?" asked Steve as he threw the dregs of his tea on the coal pile. "It don't seem to me that they've been up to much for a considerable long time."

"Well, they date back further than I can remember," answered Pete. "A good many fellows think they are of recent origin and have only just come out on the market, and while the latter is correct the former is away off. You can take my word for it that the gas engine is old enough to vote. It is said that the possibilities of the gas engine were thought of as far back as 1680, and they were going to use the gases from gun powder, but the coming out of the steam engine with radical features so different from anything that had been produced knocked the ideas of

[illegible]

[illegible]

[illegible] engineering [illegible] the engineers [illegible] know [illegible]

[illegible] answered Pete. [illegible] both gas and steam engines when their early history is looked into and compared with the engines of the present time [illegible] the early inventors [illegible] with but few changes."

[illegible] asked Bill as he [illegible] to talk and eat at the same time.

[illegible] gas engine was what we know as a two-stroke engine and the method of ignition was by means of an electric spark, and was [illegible] because of [illegible] electric apparatus.

"The first commercially successful engine was brought out about the time the war broke out or in 1860, and it was a good deal like the engines of 50 or 60 years before. Then about two years later a four-stroke engine [illegible] and was afterwards made a commercial success by [illegible] Otto. Every one has heard of the Otto gas engine and the reason for that is because Mr. Otto held patents which covered the four-stroke principle of engines so completely that [illegible] the patents [illegible] almost complete monopoly of the gas engine trade."

"[illegible] patents are [illegible] good thing in some ways," said Steve, "[illegible] a feller when he has [illegible] money enough to push the thing along [illegible] the feller who ain't got [illegible] might as well say good bye [illegible] under the notion that there's a good [illegible]"

"What makes you talk like that?" asked Bill. "Don't you think that a man without any money has got no show?"

"Well he may have a show, but it's a mighty small one if the thing he has got up is any good at all. He may have all the patents the government wants to give, but if he ain't got the money how is he goin' to defend his rights in case some old money bags takes a notion to make a device so near like the original that the inventor wouldn't know his own model? Just answer me that!

"Why, I heard of a feller some years ago who got up some kind of a thing to govern the speed of a pump, and got all the patents any one would want. He got to dickering with a pump concern, and after a while they made him a good offer, so he thought. They offered him a few hundred dollars down and a good royalty on every regulator which was sold. Well, after they had paid the money and had got the papers and the model, they put them away in the safe and dropped the matter as far as the manufacture of the thing went, while the inventor was waiting for the first pump to come out with his invention on it."

"How much did he get out of it?" asked Bill with [illegible].

"Not one cent. He got nothing, and that's what the company intended he should. When the agreement was drawn up this inventor chap didn't know enough to have 'em put in a clause which would force them to put one of his devices on every pump, and so after they had got control of the thing they just threw the whole business one side and let him whistle for his royalty and I'll be hanged if I don't think he's whistling yet. It's such things as that that makes me think a man wants to look seven ways for Sunday if he's got a patent that's worth anything and ain't got money enough to protect himself. But go ahead Pete, I guess we've interrupted you enough."

"Well there ain't very much more to tell, because when the Otto patents ran out, other manufacturers took up the matter and a large number of firms began the manufacture of small engines. Another thing that gave a boom to the manufacturer of gas, gasoline and kerosene oil engines was the discovery of plenty of natural gas and liquid hydrocarbon fuels. These fuels gave inventors a chance to put their ingenuity into practice in the line of inventing internal combustion engines, and each one had its own particular field, because naturally the gas engine was utilized where natural gas was available, while the gasoline and kerosene oil engines were utilized where that fuel was the most easily procured.

"The kerosene engine somehow or other doesn't seem to grow in favor with the gasoline engines, which is I think due in a great measure to the fact that kerosene oil which is procurable at a reasonable cost is not of sufficient purity to enable the engine to run for any length of time without the burners becoming clogged up. With gasoline engines, however, they have been largely installed in places where cheap natural gas was not available. In districts where natural gas is easily secured the gas engine is largely used, because of its low cost of operation and first low cost of installation."

"What do you think about the future of the gas engine?" asked Sam, as Pete concluded. "Don't you think it's going to make some of these engine builders step around pretty lively to hold their own, especially in small plants? I have an idea that it will, not only because of the reduced costs in the fuel bill and first cost of installation, but it seems to me in the small plant, say of 100 horsepower or so that the expense of maintenance would be so reduced as to make it an object for the power user to investigate the question. Now, for instance, take Bill's plant there. He has an engine pulling out about 100 horsepower with one boiler and a fireman to help him out. Now if his firm should substitute a gas engine or gasoline engine it doesn't take much figuring on the part of anybody to see that the saving in operating expenses would be considerable in the course of a year. The first thing to cut off would be Bill's fireman, which would amount to from $1.75 to $2 a day. Then there is the cost of the water, maintenance of feed pump and boiler, besides piping, water glasses, fire tools and other items that come in on the fireroom expenses. In the engine room the cost of operation would be about the same with the exception that it is claimed, and figures have been shown, that an internal combustion engine could be operated at less cost than a steam engine. Of course in Bill's plant they cannot do away with the boiler because they use steam, but there are hundreds of plants throughout the country where no steam is used except in the winter months and then only for heating purposes, so you see it is a proposition which demands considerable attention from everyone who is interested in the problem."

"That's a pretty good argument," said Steve, "but I kin tell you that it won't work everywhere. Now, you take a place where they just want power in the summer time; when it comes winter they have got to have a boiler to heat up with that's a going to lay idle all summer and they've got to buy a lot of coal to keep the dinged place warm, where if they was usin' a steam engine all the year round it wouldn't cost scarcely anything for heat in the winter because they could use the exhaust steam from the engine and not cost them a blamed cent. I am a good deal like Fritz. I don't like the pesky things with their rattlety bang, and when my boss gets the idea into his head that he wants a gas engine, I'm just goin' to tell him he can get a gas engineer too, for the old steam engine is good enough for me."

"Yaw; dem's my sendiments oxactly. Vots der use of bein' so onsatisfied mid de dings off loife ven der is so mooch in condendment. Vots der use?

READING DIAGRAMS.

BY W. H. VINCENT.

In reading diagrams it is necessary to remember that the indicator records absolutely indicate the performance that is going on inside the engine cylinder, providing the indicator has been properly applied. It is therefore necessary that the owner or operator of an indicator should understand how to read the lines correctly.

There are all sorts of malformations of diagrams due alone to derangement of the valves and the valve gear, and as has already been said the indicator is a most useful instrument in determining the condition of the engine regarding this important point. It is surprising to many to observe the difference in the running of an engine, as well as in the coal consumption simply by changing the position of the eccentric, the length of the valve rod or adjusting the valve gear, for by the adjustment of these parts, according to the design of the engine, almost any form of diagram can be secured. In making adjustments of valves, etc., care should be taken that the alterations are not injurious rather than beneficial, and because of the liability of wrong adjustment by the novice, he should study well the card lines and fully understand what changes the lines require if any; also what adjustments the valves or eccentrics are necessary to bring about the desired changes in the card lines.

In the last article the different lines were explained to a certain extent, but as there is so much in the subject it is advisable to enter into it to a greater length, before taking up the necessary calculations required before the horsepower, water consumption, etc., can be determined.

It would be folly for an engineer to attempt to figure these items were his engine out of adjustment, unless it were to determine just how extravagant it was. Instead of producing sections of card lines in this article, diagrams will be produced and the defects pointed out and a remedy suggested.

The diagram shown in Fig. 1 was taken from a 24 x 48-inch Corliss engine running at a speed of 74 revolutions with a boiler pressure of 75 pounds. A 50 spring was used; the mean effective pressure figured out 18 pounds. Of the 75 pounds boiler pressure the cylinder of the engine realized 74½ pounds. The steam line is about as straight as it is possible to obtain. The expansion line has a slight variation which is doubtless caused by the indicator rather than the engine. As will be seen the exhaust line and atmospheric line are one denoting the engine to be free from back pressure, which is an exception to the rule, while the compression produced, which is very slight, shows a good working exhaust valve. The engineer having charge of this engine may well be proud of its performance. It is a card that may well be imitated by others having charge of Corliss engines and when they produce a card like this, there will be little to be desired. It will be seen that the compression is not excessive, the steam is admitted to the cylinder at the right time and place and the corners are very clearly and sharply defined.

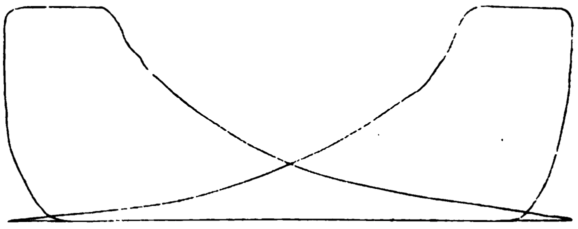


FIG. 1. A CARD WORTH IMITATING.

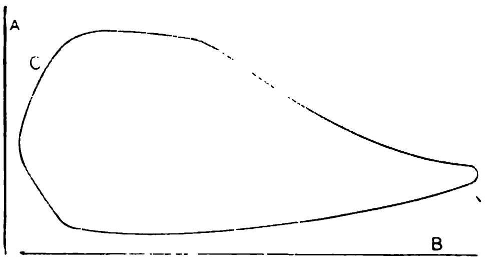


FIG. 2. SHOWING VALVES OUT OF ADJUSTMENT.

The card shown in Fig. 2 was taken from a single noncondensing engine 14 x 36-inch of the four valve type. As will be seen at first glance the valves were out of adjustment. Fig. 3, is a card taken from the same engine after the valve and eccentric had been adjusted. The line *A* represents the steam pressure in the boiler and is the same in both Figs. 2 and 3. The atmospheric line *B* runs at right angles to it. The cause for the steam line *C*, sloping in as it does, is due to a late valve motion, the valve not commencing to open until after the piston had started on its stroke. The point of cutoff is very badly defined and the expansion might lead one to think that the valve was leaking. The release is late and there is altogether too much back pressure. The whole card shows the want of valve adjustment.

Fig. 3 shows the result of valve adjustment which simply consisted of moving the eccentric which drives the steam valves so that they would open considerably quicker. The exhaust valves were adjusted to secure earlier release. Fig. 3 shows a very much less back pressure and a slight amount of compression. The steam valve opens just about early enough while the steam line although not holding up very well is a decided improvement over Fig. 2 and is not carried so far, therefore less steam is admitted to the cylinder to do the work. For this reason less steam is exhausted and much less wasted.

This is simply an illustration of what changes a little valve setting can bring about and although Fig. 3 is far from being a perfect card there are many engines running today that do not produce one as good.

The old saying "let well enough alone" can in no way apply to Fig. 2, although the engine from which it was taken carried the load and continued to operate 10 hours every day. The engineer did not care about the coal consumption as long as the engine did its work.

There is one question for the reader of this article to answer for himself. What is the use of allowing an engine to get into such a condition as to produce a card like that of Fig. 2 when with an hour's work, one might be produced like that of Fig. 3, which resulted in a saving of coal? This may be proven if both cards are figured from the same data.

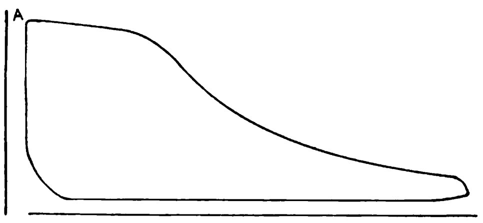


FIG. 3. RESULT OF ADJUSTING THE VALVES.

The fluctuation in the expansion line of diagrams is somewhat puzzling to the beginner. His engine may be running as smoothly as one could desire, and as far as he knows the load is steady, *i.e.* not being thrown on or off suddenly as in the case of electric power plants where cars are starting and stopping at all times or as in some manufacturing plants where the machinery is not working all of the time, but when a card is taken, it may produce lines like those shown in Fig. 4.

This card was taken from a Rollins engine, size 14 x 36-inch, running at 90 revolutions a minute, boiler pressure 80 pounds; the spring used was 40. These diagrams as far as they are worth for computing the work the engine is doing, are worthless and of no value in that respect. When a card is produced as shown at *H*, Fig. 4, it is plain that the trouble is due to the engine taking more steam in the crank end of the cylinder than in the head end. This naturally tends to increase the speed of the engine on the stroke toward the head end, and as a consequence the governor balls are raised slightly and the head end valve trips a little shorter in order to maintain the proper speed. head end has taken less steam than the crank governor balls drop and the crank-end take longer, in an endeavor to maintain the speed c

The sum and substance of the matter is that of the engine is doing more work than the ot and the other end is trying to do its part to l speed where it belongs. This unbalanced perf causes the governor to change the point of c every stroke of the engine.

These diagrams were taken with a three-w placed midway between the two ends of the (consequently the exact variation of speed in o lution is not shown.

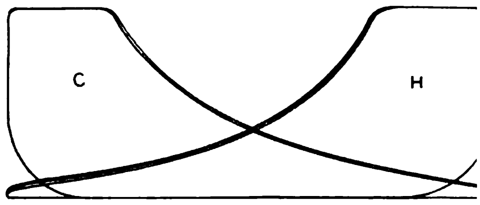


FIG. 4. SHOWING A FLUCTUATION OF THE GOV

There is more to such a card than is at firs ent. It means that the speed delivered to the ery is not steady and therefore less work is b complished by the operation. When an engi adjusted it requires more steam to do the same of work. This of course is a call upon the (and it is therefore important for the enginee serve the seemingly little things.

These two diagrams bring to mind a small lighting plant located in a small town in the west. The plant was not paying expenses; tl flickered in every household and no one se know where or what the trouble was unless the engineer who would not tell if he did kno trouble was blamed on the transformer and in the town knew any better. Subsequent e tions of the engine showed that the trouble the valve adjustment, which produced a card to the one shown in Fig. 4. Probably inca lighting will reveal engine fluctuation about as as anything, the indicator excepted.

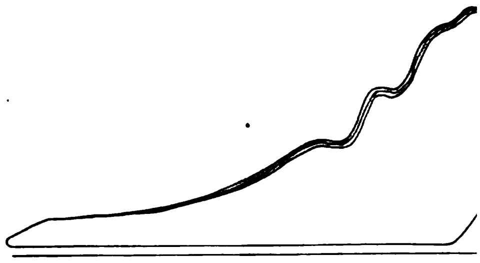
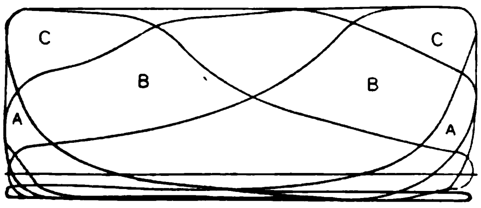


FIG. 5. CARD DUE TO FLUCTUATION OF LOAD AN SPRING.

Some years ago while operating in a man ing plant, this fact was brought to the writer tion. The plant was lighted by a small dyn though amply large for the purpose. It was l ter shaft, which in turn was belted through the room wall to the line shaft in the shop. Of a fluctuation of speed in the engine meant con- le by the time it reached the dynamo. The was running in a very satisfactory manner he exception of a thump and the lights were when I took charge, but the evil genius that to take possession of an engineer and cause change everything upon taking charge of a new (young engineers are usually subject to the attacks,) overcame me and the engine was ac- gly adjusted by the rule of thumb method which gh not so commonly used now as in the past is evalent with too many engineers.

change was quite noticeable in the lights and gh the engine seemed to operate better and did e respects as the thump had disappeared, the had a way of winking at every revolution of gine that was most embarrassing. As I was dly well aware that the trouble was of my own g I lived in a constant dread lest the superin- t should inquire as to the sudden change in the ion of the lights. The engine was indicated by d the next day, which showed that the adjust- had not been even, therefore one end of the r was doing more work than the other. In other the engine was working as has already been de- . This little incident convinced me then and f the value of the indicator and although quite years have passed since, I have had no occasion k otherwise.



THREE DIAGRAMS TAKEN FROM THE SAME EN- DURING A PERIOD LESS THAN SEVEN MINUTES.

claim made by some engineers that they can w an engine is taking and using steam by the of the exhaust motion of the valve, etc., is far rue. There is no way of telling anything about going on in the cylinder of a steam engine until icator has been used and the cards read by a who understands them.

diagram shown in Fig. 5 was taken from a Por- en tandem compound engine, the boiler pressure 150 pounds. The card has no value in deter- anything relative to the performance of the en- At the time this card was taken the high pres- linder was doing all the work, and exhausting e air, the low pressure cylinder valve gearing disconnected for repairs. This is not only a fluctuation but shows that the indicator was at The number of expansion lines are caused by vator load which fluctuates. The wavy appear- due to the speed of the engine and is intensi- m the fact that a 60 spring was used, which t stiff enough. This goes to show how a card distorted when the conditions are favorable. her case of variation in the expansion line is in Fig. 6. These diagrams were taken from a double eccentric Corliss engine, size 18 x 42-inch, revolutions 96 per minute; a 60 spring was used and the boiler pressure was 110 pounds per square inch. These diagrams were taken with a view of showing the variation in load to which an engine may be subjected. The smaller diagram *A, A,* shows the engine working under a frictional load only; *B, B* under a medium load while *C, C* shows that the engine was working with a heavy overload. It may be of interest to know that these three different sets of diagrams were taken in less than seven minutes.

It will be seen by even those not acquainted with indicator diagrams, that they are a study in themselves, as the formation of each and every line tells a story of its own, but the shape and position of the line in relation to the other has all to do as to what the story is to be.

Seeking Water Power.

The lesson of the use of Niagara falls for generating electricity has been put to worldwide application, says the New York *World.* Throughout the world, falling water, according to a paper read before the British association by Mr. Campbell Ewinton, yields to man's use an energy equal to 1,483,390 horsepower, of which Great Britain figures for only 11,906 horsepower. The British Aluminum Company gets 7,000 horsepower from the falls of Foyers and it expects presently to procure 17,000 horsepower from Loch Leven. The North Wales Electric Power Company is about to tap Lake Llydaw, on Snowdon, and hopes to obtain 8,200 horsepower for every working day of nine hours. Finally, the Scotch Water Power syndicate is peering round in quest of waters that it can imprison at lofty levels and so generate electric power. From Loch Sloy, 757 feet above Loch Lomond, it is going to get 6,600 horsepower, and at Ardlui, higher up, it proposes to get further energy. Even a modest stream that drops several hundred feet may be a source of power.

Coal Production.

Estimates of the production of coal during the past year indicate an output nearly as great as in 1903, when the production of bituminous coal was 285,000,000 tons and of anthracite 59,000,000 tons, a total of 344,000,000. In 1904, the output of anthracite was 57,492,522 tons and the estimated production of bituminous coal 281,000,000 tons, a total of 338,000,000 tons. During the year our imports of anthracite were 75,526 tons, as against 151,023 tons in 1903; and of bituminous coal 1,556,149 tons, as compared with 3,295,379 tons in 1903. Our exports of anthracite in the past year were 2,228,392 tons, as compared with 2,008,857 tons in 1903. Bituminous coal exports in 1904 were 6,345,126 tons, as against 6,303,241 tons in 1903 and 5,218,969 tons in 1902.

Locomotives For Japan.

Carrying a cargo of 24,000 tons of freight and 57 locomotives for Japan, also a large passenger list, the steamship Minnesota cleared from the port of Seattle, Wash., recently for the Orient. The locomotives are consigned to Yokohama, and are to be used on the railroads of Japan and Manchuria. They are of the Japanese standard gauge, 3 feet 6 inches. Five more will be shipped from Tacoma, Wash., soon.

REPRESENTATIVE MEN FROM THE ENGINE ROOM.

Earl C. Bliss, whose photograph accompanies this sketch, was born on a farm in Newbury township, Geauga county, Ohio, April 8th, 1872, and educated in the public schools of Burton, Ohio. He entered Case School of Applied Science in 1892 as a special student and later on was employed in the shops of the Brown Hoisting & Conveying Machine Co., as a machinist, at which trade he had worked before entering college. He accepted a position with the Chagrin Falls Electric Co. of Ohio, in the fall of 1895, as an allround man, leaving their employ in the spring of 1896 to construct a telephone system for the Burton Telephone Co.

In 1896 Mr. Bliss secured an electric light franchise for the town of Burton, although people had no faith in the enterprise. He only had $135 and together with a Mr. A. W. Burnett bought a 7½ kilowatt generator, rented a traction engine, built a rough board building and began business January 6, 1896, as the Bliss & Burnett Electric Co. with 69, 16 candlepower lights wired in.

EARL C. BLISS.

The boiler was leaky, but by working at it days they were able to run evenings. In March, money was borrowed and an old skating rink leased in which was installed the new machinery, which was purchased with the money at their disposal. The new plant barely paid expenses and Mr. Burnett released his holdings a few months later, Mr. Bliss assuming all obligations. Business soon increased and debts were cancelled. Mr. Bliss then bought the land and rink and tore down the building except the portion covering the plant which has been entirely built over. At present he is engaged in installing another generator and generally enlarging his equipment.

THE IDEA·EXCHANG

Readers are cordially requested to contribute to this departı
pay for all letters used. Write as you would to a friend,
would talk. Correct spelling and perfect grammar are un
Interesting experiences, new kinks and ways of doing work,
on other letters and articles on subjects pertaining to the p
transmission and use of power are acceptible. Illustrations
value of descriptive articles. Plain pencil sketches are sufficie
sheet should bear the names of the article and the author.
hear from YOU.

Compression of Steam.

Editor of the Engineers' Review:

I noticed the article on compression of st
steam cylinders in the March number of the
by T. P. I have read a great deal on thi
mooted question, and when one has finishec
about as much in the dark in regard to adv
or economy of compression, no compression, le
no lead, as when he commenced.

I am not a technical educated engineer, and
propose to delve much in technicalities or thec
I will just give you my views and experience
experience of others along this line.

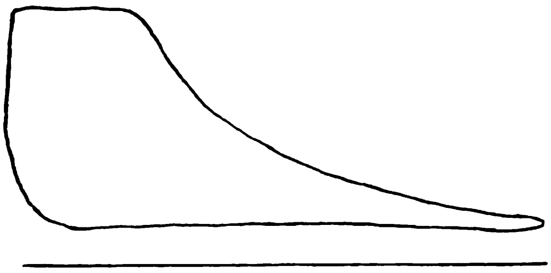
I am a firm believer in compression up to
limits. In the first place I find it conducive to
running of the engine and in the second plac
sists in bringing the piston to a stop easily b
ioning it at each end of the stroke, so that
versal of travel of the piston is accomplished
any undue strain on any of the parts.

Again, the clearance space is partially fill
steam that has already done work and does
quire as much live steam from the boiler to
clearance space, which I claim is a saving in

All the experts on indicator work that I ha
advocate compression up to about two-thirds
pressure, and some to nearly boiler pressure.
not believe in excessive compression. I c
about one-half boiler pressure is right, at leas
experience I have obtained the best results w
limit.

When it comes to lead I never could see the
admitting steam to a cylinder when the engi
on the dead center. It is certain that the c
that position has no leverage to turn the sha
any power exerted on the piston at this time is
opinion, simply wasted, and even after the cr
moved just a trifle off the center the thrust is
in a straight line and very little, if any, power
the engine is developed. Just place a Corliss
on the center and then turn it by hand until th
moves a little off the center, then work the val
by hand, admitting steam to the cylinder, an
the engine will start. I have tried it several ti
have failed until I moved the engine far en
give the crank some leverage on the shaft to
Then consider the thrust or strain there mus
the wristpin, crankpin and main bearing, wh
boiler pressure is admitted to a cylinder with
gine on the center. I have experimented consi
along this line, and by actual weight have sav
siderable fuel by having my steam valves a lit
something like the illustration.

I recall an experience an engineering friend of mine had with an engine. He was sent to indicate and adjust the valves on a 24 x 48-inch Corliss engine, running non-condensing, which had a very bad pound in the cylinder. The engine furnished power for a large wood working establishment. Of course, they used the refuse for fuel, and the boiler was none too large for the work. He found the steam valves were late and the compression about one-third boiler pressure. Even after adjusting the steam valves to give more lead, and putting a little more compression on, the pound was still there. He then took off the cylinder head and found the cause of the pound in the piston. This was then repaired. The engine was started up again with the valves adjusted, showing a trifle lead and about one-third compression. After running a short time the regular engineer complained that he was burning too much fuel and that he would be unable to keep up steam in the boiler without using coal to help out, so my friend put more lap on the steam valves, making the diagram show quite late, and the engineer in a short time was happy and had time to look around a little, and had no trouble in keeping up the steam. Now this, to my mind, shows clearly the advantage of lapping the valves.



ADMITTING STEAM A TRIFLE LATE.

Another case similar was related to me by an erecting engineer employed by a builder of Corliss engines. He said he was sent to a place to rebore the valve chambers and put in new valves on a Corliss engine in a saw mill, where they used sawdust for fuel. He applied the indicator to the engine before commencing the job and found the steam valves very late. After completing the job he set the valves, giving them a little lead so that the admission line showed about straight. After running a little over half a day the engineer complained that the boilers were firing very hard and his fuel was running low. The erecting engineer, just as an experiment, gave the steam valves more lap, making the diagram show quite late, and after running that way for a while the operating engineer said the boilers were working easier and the sawdust piling up. No other changes having been made, what caused this if it was not having the steam valves late? I give these two instances to show what is found in the experience of others as well as my own.

I have run the engine I am in charge of for over seven years and at times it is heavily overloaded. I have never had any trouble with the main bearing heating up, although I use a cheap grade of engine oil. If you place your hand on the main bearing and shut the eyes you cannot tell when engine passes the centers, but give the engine lead and not much compression and you can tell very easily when it passes. I do not believe that lead on an engine is necessary to get the best results. H. S. C.

Does Not Agree With Mr. Johnson.

Editor of the Engineers' Review:

I would like to make a few comments on Mr. F. L. Johnson's letter, published recently, in which he comments on W. J. D., moving his exhaust eccentric ahead, and thereby increasing the compression of the engine, to make it run more quiet. Mr. Johnson says both compression and lead are not necessary to induce smooth running, if the engine is properly keyed up. He also states that steam is used to turn the crankshaft and steam used in this manner creates friction and heat that is unnecessary.

If an engine is running without lead or compression and is keyed up tight enough to make it run without noise, I will guarantee that it will develop many times the heat and friction of one that has the proper cushioning. He also states that compression decreases the area of the indicator diagram, and maintains that all compression, whether great or small, is a dead loss. I want to show the readers that Mr. Johnson's letter looks very feasible from his point of the argument, but in looking at his diagrams we notice there are several other things to be taken into consideration that will cover his economy, as well as allow the engine to have the right amount of compression, etc.

He overlooked the fact, or else never thought of it, that there is some clearance in the end of the cylinder which must be filled up from somewhere. As an example we will take an engine with a 14 x 14-inch cylinder, cutting off at ¼ stroke, which is very good practice. This clearance is about as small as the engine builders of this country make it, but in the old country, where they have the steam valves in the cylinder heads, it is sometimes a little less. This engine could easily run 250 to 275 revolutions a minute. If running at 250 revolutions, this clearance would have to be filled up 500 times a minute. Think of it! Now, if the engine had a proper amount of compression in it, the saving would be fully three-fourths of this needless waste, to say nothing of the advantage of smooth running. I do not approve of having lead in a four-valve engine of any kind, where the exhaust valves may be set independent of the steam valves, for then the clearance can be filled and cushioned with steam that has spent its force in useful work, and thereby save that amount of live steam from the boiler. Where you have a single valve engine with no chance of cushioning it off with compression, it is then up to you to give it lead to cushion it off.

Mr. Johnson also says that too much lead will show up the loose parts of an engine more quickly than anything else. This may be true if the lead is excessive. But to do as he says, "do away with both lead and compression and you will take two steps in the right direction," I don't approve of that a little bit. There are thousands of engines which are doing good and economical work that, were they to be deprived of their cushioning, either lead or compression, they would be in the junk pile and the engineer wearing a woolen overcoat before his pay day rolled around.

Engines which run at a high rate of speed would soon get hot and melt out the crank boxes, also the main bearings in a few minutes if they were to be keyed up tight enough to run smooth. If they were loosened up enough to run without heating, they would soon pound the crankpin off or else break off at the wristpin.

In regard to the indicator diagrams in which he gives a tracing of a 1,200 Allis-Chalmers engine, I will say that it would be quite easy to make it run smooth if it is a cross compound, having a very long stroke and running at a speed of about 50 or 60 revolutions a minute, but if the cylinder has very much clearance there is no economy in that. Increasing the indicator diagram by reducing the compression, also increases the rated horsepower, but at the cost of the coal pile and the cost per horsepower hour is not reduced.

Now just one thing more: He says the time to admit steam to the cylinder is when the crank has passed the center. Ninety-five engineers out of every 100 will agree with me that this is not the time to admit the steam. The proper time for admission is when the engine is on the center and not after it has passed it.

If an engine is not allowed admission of steam until it has passed the center, by the time the port is wide open the engine piston is traveling so fast that it is impossible to ever get near enough initial or boiler pressure to bear against the piston, thereby destroying most of the expansive power of the steam, and so loose in the matter of economy.

An ideal way to satisfy Mr. Johnson is to have the valves set in the way he states, and then have them as I advocate, having the engine run a like period under like circumstances, weighing both the coal and the water. He will very soon see, as well as be convinced as to which method can be used to the best advantage, in making an engine run the most economical, as well as the smoothest, after taking into consideration needless friction from tight keying up of bearings.

I will state here that I have no bone to pick with Mr. Johnson and do not wish to down him in any way. I have no doubt he is sincere in what he states, also that he means well in what he says, but it looks to me as if he has not experimented enough or else not thought of all sides of the matter before he presented his case.

I will say in reference to the letter from O. E. W. on page 16 in the February number, that I had trouble once almost exactly as he states with a four-valve Russell engine having a knock in the cylinder. I had looked over and tested very nearly everything about the engine, had taken cards, etc., and after all this investigation, I was then as far as ever from the correct solution.

On this engine I had a steam separator, but had not suffered the least trouble with water in the cylinder, I finally concluded that the trouble was with the piston itself, as I had had two sets of rings broken in the cylinder without apparent cause. I ordered a new piston and rings and put them on the old rod and since then I have had no trouble. In examining the old piston after it had been broken up I found several thin places in it which must have caused the piston to spring and bind the cylinder. It was hollow and cored out in the usual way. J. K. Mercer.

Compression a Threadbare Subject.

Editor of the Engineers' Review:

I wish to say a few words which I hope will be well taken in regard to articles which are under discussion in the Review.

The letter by W. J. D. in the December issue, has brought up this threadbare subject of compression but there is one thing to be considered which seems to have been ignored in his article. In the first place W. J. D. should have presented a diagram from his engine when asking the question. Then again where does the compression subject come in? What has he to compress? He says this is a compound condensing engine. Therefore the low pressure engine is exhausting into a vacuum and if there is anything to compress it is a vacuum. It is evident, therefore, that he is not being hurt financially by compression of his vacuum.

Referring again to the subject and answering his question as accurate as possible without a diagram, I will say from the fact that his engine is running more quietly it is evident that the energy which has been causing the pound has been absorbed and probably is being converted into useful power, but without the diagram one cannot tell. In order to get much cushion on a condensing engine it would require considerable advancement of the exhaust eccentric and this advancement could be governed by the release line of the diagram. If enough cushion is not apparent I would advise that the steam eccentric be advanced giving admission early enough to bring the desired cushion on the piston.

It seems to me that some of the correspondents have been pouncing onto Mr. Wakeman rather rough shod. There seems to have been some things misunderstood in his correspondence that has brought out so much criticism. I cannot see where Mr. Wakeman has erred very much.

Now about this question of deception, I am afraid some of the conscientious engineers who have been writing on this subject have been practicing deception. I don't care to enter into a religious argument here and therefore, will only say, that with those whom a man has business relations, it certainly is his just duty to be honest as long as it is not to the detriment of his fellow men from a conscientious standpoint, but when people are prying into personal affairs which do not concern them, I advise any man to protect himself.

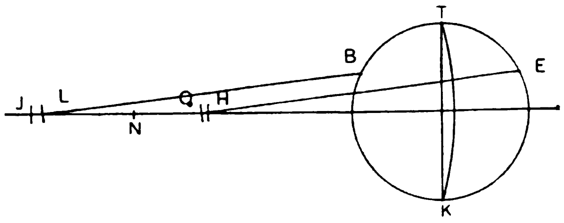
Most any man ought to be able to judge for himself when he is doing right or wrong, and deception may either be right or wrong as the case may be. It is useless to cite cases, as every man in the land has examples plainly before him.

Mr. Geo. G. Bennett tells us in the March issue that he has very little use for stop-cocks in the blowoff pipe, and explains the energy exerted upon it, if it is suddenly closed. Now any man that hasn't judgment enough to shut a stop-cock slowly, isn't competent enough to be in a boiler room. C. B. Risley.

Made an Error.

Editor of the Engineers' Review:

I wish to acknowledge an error in my crosshead problem, which should have been, as "Motor" says in the April issue. The crosshead travels less for the same movement of the crank on the outer portion of its stroke than it does on the inner portion. "Motor" not agree with me on what causes the difference een the two points in the problem. He says ;then the connecting-rod and you decrease the rence, shorten the connecting-rod and you in- ;e the difference." That is true. Again he says, : the scotch yoke instead of the connecting-rod you have the same motion of the crosshead at ends of the stroke." That is true also, but ıer one of these has anything at all to do with ›roblem in question. As "Motor" says, "The differ- is not because one-half of the crankpin circle es away from the crosshead and the other half rds it, but the difference is due to the angularity ıe connecting-rod."



VING THAT THE CRANKPIN CIRCLE CURVES TOWARD THE CROSS HEAD.

the problem under discussion, the connecting- n the position *L B*, we will assume is on an angle › degrees. When it stands in the position *O E*, it be on the same angle, 20 degrees, which shows : can be no difference in the angularity of the con- ng rod in these two positions, still it shows less : between marks *O H*, than *J L*. Now take a ıs equal to the connecting rod, as it stands in the ion *N T*, and draw the arc to *K*, which shows plainly that one-half of the crankpin circle curves rds the crosshead and the other half away from Surely there are other engineers that understand problem, let us see who is right. A. L. J.

Piston Travel.

ɔr of the Engineers' Review:

the article by J. T. Welsh on page 34 of the :h issue, he states there is no exterior part on an ıe that will change the length of the stroke, but Mr. Wakeman is right when he says the piston :l can not be changed outside of the cylinder and there either without changing the length of the der.

order to change the travel of the piston, it is very ssary to change the length of the crank, as the :l of the piston is in all cases twice the length of :rank. This rule is as fixed and inflexible as the of nature.

r. Welsh states also that when Mr. Henderson the ⅜-inch shims to make his piston travel evenly een the heads he did not change the length of the :e, but simply changed the length of the connecting This I think is correct, but when he says the results can be secured by changing the position of ·ccentric collars, I cannot see it that way.

:ither the eccentric, or its collar has anything to ith changing the length of the connecting-rod, the cylinder clearance, the length of the stroke, or the location of the piston's travel. Furthermore the piston travel can be changed without changing the length of the cylinder. J. C. Scott.

Keying up Brasses.

Editor of the Engineers' Review:

I did not intend to enter into a controversy with any one regarding anything which has been published in the Review. It is something that I do not like, and I am beginning to think I was not wise in writing for publication. The only thing I have for an excuse in writing this letter, is that I do not like to retreat under fire. Therefore I desire to have one more opportunity of entering into the discussion and then I am through. Mr. Wakeman makes the statement that I was mistaken when I said, the travel of the piston changes as the brasses are worn and keyed up.

My first letter will show that the travel in the case mentioned is that of the piston in relation to the cylinder and not the crank. While the piston may be traveling over a cylinder surface of, say 36 or 48 inches, the piston does not always travel over the same surface due to the keying up of the brasses. I uphold my first statement, notwithstanding Mr. Wakeman's argument in which he says, that such an unqualified statement is not correct. He then says there is an engine near his desk as he writes in which adjusting the connecting-box brasses for wear does not change the distance between the centers of the crank and wristpin.

There is also an engine near my desk as I write, which has practically the same type of adjustment as Mr. Wakeman calls attention to, which is, I presume, a type of connecting-rod wherein the adjusting wedges of the brasses are placed, one inside and one outside of the crank and wristpins. This adjustment equalizes the wear of the boxes, thereby preventing the lengthening of the connecting-rod which would occur in most cases if both wedges were put inside of the pins. This would, as has been said, throw the greatest amount of clearance to one end of the cylinder.

Mr. Wakeman objects to unqualified statements, and he is right, therefore I presume he will give others the same privilege that he grants himself. He states the adjusting of these types of connecting-rod brasses does not change the distance between the centers of the crank and wristpin. That is an unqualified statement from my point of view. It is evident that Mr. Wakeman has different brasses in his engine than any other engine which is in operation today or in the past. Never were there two pieces of metal which would wear in exactly the same degree, no matter where placed, nor two set of brasses which wore to the same extent when doing the same work on different engines, because it is impossible for the same conditions to exist in different cases. The idea of brasses on the same engine wearing the same is not to be entertained for a moment. It matters not how the adjustment is made, the one set of brasses will wear more than the other.

It is doubtful if Mr. Wakeman will claim the wristpin and crankpin brasses wear the same. If they do not, it makes no difference whether the keying up is supposed to take care of the length of the connecting-rod or not, the thing is an impossibility and the clearance in the cylinder is changed. Of course if the brasses wear exactly the same the clearance will remain the same no matter how much they are adjusted. If Mr. Wakeman has had different results I wish he would tell us what he uses for brasses and all about them.

C. G. Stockwell.

Fitting Brasses.

Editor of the Engineers' Review:

This subject has been brought to my attention from the fact that we have just been fitting new crankpin brasses to our engine which has a 14 x 32-inch cylinder. We put the new brasses in the strap, separating them by one thickness of Russia iron as shown at *A* and *B*, Fig. 1. Then the strap with the brasses was placed in a lathe and centered on the face-plate in the usual way. The crankpin was then calipered and two thicknesses of Russia iron were placed under one leg of the calipers and the brasses bored to this size. When the liners in the brasses were removed the brasses were ready for fitting.

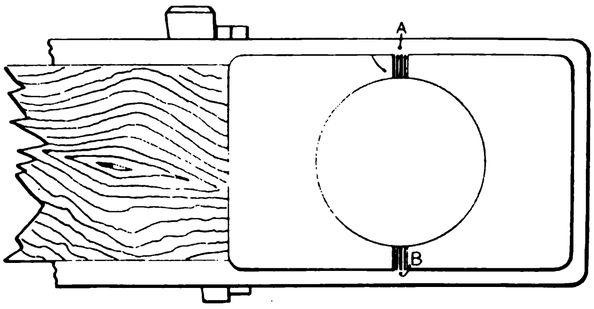


FIG. 1. BRASSES SEPARATED BY RUSSIA IRON LINERS.

The purpose of boring for an over size is to give ample clearance at the top and bottom as shown at *C* and *D*, in Fig. 2, where no work is done and where a close fit is not at all necessary. It is better to have loose fitting brasses at this point in order that the pin may be lubricated better. This same operation will apply to old brasses as well, when they are to be rebored.

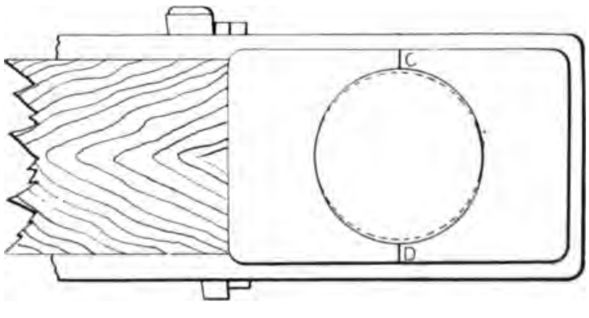


FIG. 2. CLEARANCE AFTER BORING OUT.

In order to find out whether the crankpin was round and in good condition a little lampblack and oil was mixed into a paste, and the pin covered with it, spreading it as thin and evenly as possible and just enough to mark the brass. Both brasses were then placed together on the pin and keyed up in the strap with a piece of wood in place of the butt end of the connecting-rod. By keying them up tight enough to allow the straps to turn easily on the pin, without lost motion, the spotted places showed where to scrape when the brasses were taken off. This operation was repeated until a proper fit was obtained. We find that brasses fitted in this way do not have to be worn down to the pin, but will, if properly keyed, run from the beginning without any heating.

W. A. Holcomb.

His Governor Pounds.

Editor of the Engineers' Review:

Last October I obtained a position as engineer, running a 70 horsepower automatic governor, balanced valve engine, running under or away from the cylinder. The valve is in perfect condition, as to clearance and lead, as is also the piston. The engine is running 210 revolutions per minute with about 100 pounds boiler presure. It runs smooth except at intervals which vary. The governor, which is the Westinghouse automatic, will without apparent cause or previous notice hammer or pound, especially when laboring, but not when running light. At one time it ran perfectly smooth for three weeks. Good engineers have inspected this governor, but all of no avail. Can any of your readers give a reason for this trouble?

M. A. Stedman.

Leaking Steam Valves.

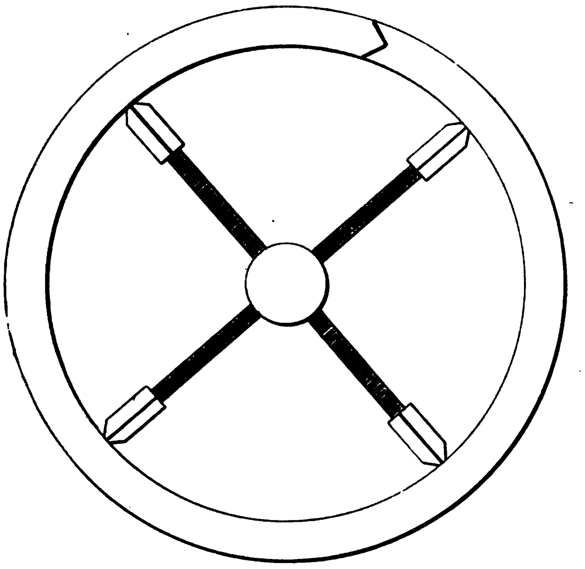
Editor of the Engineers' Review:

I have noted in the Review of late, several letters referring directly or indirectly to losses and wastes in the steam plant, but one leakage which probably is the cause of more steam waste than any other, is that of leaking steam valves. When a valve leaks steam enough to make it known through the lines of an indicator diagram, it amounts to a considerable portion of the steam used and the leakage must be excessive if it is sufficient to make 1 or 2 pounds difference in the terminal pressure, either greater or less than it would be due to the point of cutoff. The expansion curve of the diagram often drops down below the theoretical line and this is due to piston leakage, which has the same effect as leaky valves on the economy of the engine. Leakage of the exhaust valve can be readily detected by the compression curve on an indicator card. If there is much compression, the leakage has reached a considerable percentage. The ordinary leak must be determined in a different way and this is the point which I wish to bring out.

I think the best and easiest way of testing for leakage of steam in the exhaust valves or piston is by blocking the engine, turning on the steam and noting the escape of steam from the cylinder drips. In some cases a better way would be to remove the cylinder head before making the test. When the engine is of a type that has a valve motion consisting of a releasing gear, etc., so that the valves may be centered, the ports are easily covered. When steam is applied by opening the throttle, if there is any leakage in the valve it can be detected at once by the escape of steam from the exhaust pipes or cylinder cocks. Leakage past a piston may be found by blocking the engine in position, so that the steam valve on the crank end is open. If the cylinder head has been removed and steam is applied, the leakage of steam by the piston is easily detected.

One mistake in making engine tests in this way is due to the fact that the piston is blocked in one position only. It should be blocked in different positions so as to bring the piston in different parts of the stroke. This is necessary because a cylinder usually wears uneven and is frequently largest in the center. If a test is made in this manner, many engineers will be surprised to find how badly the valves and piston are leaking. This method gives them also a better general idea as to the amount of leak and by experimenting this way and then taking an indicator card, they have presented to them a clear idea as to just how little show the amount of steam which is leaking would make on the indicator diagram. This can be ascertained by laying out on a card, the theoretical expansion curve and then attempt to calculate the extent of the leak.

Care should be taken in placing the blocking for an engine, for this kind of a test, or injury may be done. Sometimes a block can be placed under the arm of the flywheel near the rim which will hold the engine with all the pressure necessary to be used. In making this test with the valve open, only a low pressure should be used, because a leak that will not show up under small pressure will not amount to very much more under a high pressure. Some engineers place the block between the guides when they are of the locomotive type and when the crosshead is brought up against the blocking, a gentle pressure can be put on the piston without danger of injury to the engine. A block should never be placed against an arm of a wheel close to the hub because this would allow of a strong leverage and it might possibly break the arm. When an engineer is making such a test, he should be sure that his blocking is placed securely so it will not be possible for it to slip from its position after steam has been turned on.



DEVICE FOR SPRINGING PACKING RINGS OVER PISTON.

I recently had occasion to put a snap ring on the piston of a tandem compound engine of the high pressure cylinder. If any one has undertaken this job they know what a difficult one it is and have doubtless come to the conclusion that there is no snap about it, for no sooner is the ring started on one side than it slips off on the other and the constant fear of breaking the ring is pretty sure to prevent the engineer from doing anything rash. In the illustration is shown a method which we use. We obtained four pieces of square iron, cutting them off about 3 inches in length, threading them to a depth of 2½ inches. One end of the blocks was made tapering coming down to a sharp point to prevent slipping of the ring surface. The four bolts were threaded and screwed into the four blocks which were placed into position as shown in the illustration. When we were ready to put the ring on the piston the bolts and block were put in place and tightened up so as to spring the ring evenly until it was large enough to slip on over the piston. We found this method to be much easier than the old way of pinching and prying the ring into position. This method is not original with us, having been handed down from our forefathers.

M. G. Wilbur.

Engines That Race.

Editor of the Engineers' Review:

If there is one thing more than another that gives an engineer a tired feeling it is an engine that will race. Some of them will do so no matter what is done and once in a while the engineer is able to find out the trouble and remedy it. Sometimes I am inclined to think that some engines can't help it as they are made that way, while others get it from their surroundings which may be full of bad air filled with dust.

While a racing engine is entitled to a great amount of sympathy, the engineer who is running it is deserving of more.

It is easy enough to say that if the engineer will sit down and think of all the things that have been known to cause an engine to race and after setting them down on a piece of paper and then go over the engine and make sure that none of them has anything to do with the trouble, that he will at last find the cause and then his trouble will be at an end.

While this is so, frequently more than one remedy will come to mind. Again the fault will be so serious that it cannot be remedied by any reasonable changes, or the remedy may be of such expense or of such a complex nature as to not allow of its being applied.

Some engines race as soon as the load begins to come light, although they may be as steady as required when the load is heavy. This is especially true if the engine is equipped with a shaft governor, when it will begin to misbehave immediately, and the only thing for the engineer to do is to throttle it down and run the rest of the turn with the throttle open only three or four turns. There are a good many of your engineers who have had this trouble to contend with, or I will miss my guess.

Sometimes the trouble can be overcome by turning the throttle nearly closed and then open it very slowly, but there is nothing very sure about the engine staying with you for long, as the least variation will cause it to get on the race track again.

If an engine starts to race when sudden and considerable increase in load is thrown on it, the reason is this: the governor has to go down to the limit of its travel, but if the engine has not the strength to race and don't run away it is simply because it can't, as the load is greater than it can pull. When this occurs engineers say the engine is working down on its collar, meaning that the governor has dropped to its greatest extent, and has all the load it can handle.

When an engine having a shaft governor begins to race there is not much the engineer can do, except to partly close the throttle, because he cannot hold the governor. With the fly-ball governor the engineer can watch the governor and if he knows how, can help the engine considerably in the trouble. There are two ways to help an engine when it races. When the engine starts to speed up the action of the valve can be kept down somewhere near where it should be by helping the governor with the hands, but this does not stop the trouble, only help, and the engineer is really making a dashpot of himself.

When an engine speeds up the governor is expected to move up, but it cannot move first, although it is expected to get in its new position, due to an increase of speed, at a moment's notice. Every governor has a certain amount of friction which must be overcome before it moves and this makes it a little slow, therefore the less friction there is in a governor, the nearer the governor will come to operating on time. The delays in the movements of the governor is what causes the trouble. If the load were always the same and the steam pressure did not vary, the governor would have nothing to do. The aim of a dashpot on the governor is to hold it practically still and in one plane until the sudden change of load is over.

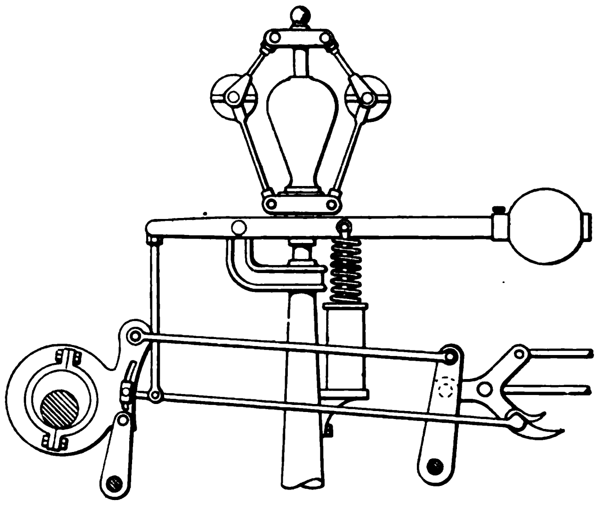
The governor assumes an average position and stays there, changing slightly one way or the other. When the load increases the engine slows down and when it decreases the engine speeds up again and if this fluctuation in load is very frequent and sudden, the governor stays in practically the same position. When the change is great, however, the governor will move after a very short space of time and take a new average position. It is not only possible, but an absolute fact, that loads may vary so much and so sudden that a governor, no matter how well designed, cannot follow and keep up with the changes.

The dashpot often makes the regulation bad, although its very purpose is to make the governor pay no attention to anything, but a considerable change in load. The amount of load which the governor will pass unnoticed depends on the size and stiffness of the dashpot. Usually its resistance must be proportioned for the particular load it is to care for and this may be done by either adding thin oil to thick oil in the dashpot cylinder or by regulating the openings in the dashpot piston which are for that purpose.

The friction of the governor really acts as a dashpot, as it tends to resist motion, but it should not be lost sight of that friction does not make a good dashpot as it is always changing through wear, and even with no wear the resistance of friction would never seem to be twice alike.

When a man is holding a governor back, he simply keeps hold until the load comes on again and the engine speeds up, but the governor acts in a quiet manner because the man is usually pushing when he should be pulling. When a governor is about to raise, it should be helped and not hindered. An engine usually gives notice of its intention to speed up when it has one of its racing moods on and this is the time to take hold of the governor rods to help move it in the right direction, or in the direction it would take if it could. This results in the governor being right on time in this movement. When the hand is placed on the governor it should yield if it is done right. If it does not yield it is evident the governor is trying to go the other way and it is time to stop pushing and do a little pulling. When the engine is slowing down the operation is reversed and the hand ought to pull it down a trifle. Every engineer who has had experience will know what is going to happen when his engines get in such a mood and the indications from the action of the engine shows him which way the governor should move.

The fact that he can help his engine should suggest that a remedy is possible. As a usual thing, the governor moves hard in two or more spots. When the load decreases the governor speeds up but does not raise until the engine has gained quite a little headway, then the governor operates and goes too far, in fact it gets so much momentum that it goes up past the spot where it should stop due to its own inertia. This makes the engine lose its headway because it gets little or no steam for three or four strokes, while the load is on just the same. The governor stays up in this high position until its weight is enough to overcome the resistance of the sticking point which when overcome allows the governor to drop to its lowest position, and then the operation is gone through again.



SHOWING THE SPRING WHICH WAS REMOVED.

When this occurs the engineer should make an examination, and will usually find that the trouble lies in something which binds just a little at the two extreme points of the governor travel. It may be that pins bind when the lever is away over to one side or a cam may ride up on a high spot. With the high speed engine having a balance valve there is a chance of its riding on the shoulder at the end of its travel.

The engine oil becomes sticky after a time and the amount of force necessary to move the cam when disconnected from its rod, is somewhat surprising because of this. In such a case a special light oil for governor gear is worth trying, but sticking points can best be helped with a file. The best way to find sticking points is to make a spring scale and move each part by pulling on the scale through the whole length of its travel. If the pull increases three or four pounds, it is evident there is a reason for it, and by making a sketch and marking each lever with the force needed to move it, will enable the engineer to tell where the friction is in excess of what it should be.

A peculiar incident came to my attention a few days ago. It was the case of a Porter-Allen engine equipped of course with the regular Porter-Allen governor. This governor has been bothering for five years or more and while the engineer is a worthy, competent man he has been unable to remedy the trouble, although he has tried every scheme that has presented itself to him. In the illustration is shown the Porter-Allen governor. This engine is direct connected to a generator and pulls on an average about 1,000 amperes. The engine runs at a speed of 250 revolutions a minute. The load on the engine consists of lighting, motors and elevators, there being four of the latter. When these elevators are started the sudden load is not met quick enough by the action of the governor and consequently the voltage drops. This fluctuation causes the lights throughout the building to dim and brighten up as the load changes, in fact the governor did not govern. A spring was placed on the dashpot rods as shown and while this helped matters somewhat it was far from being satisfactory. On other occasions this spring and the spring which is located on the inside of the dashpot were removed, but the engine acted so much worse that it was not deemed safe to operate it in this way and the springs were put back in place again. Several competent engineers had been invited to try their skill upon the governor and although they all worked along the same lines as the engineer in charge, none of them had success in remedying the defect.

This is the way matters stood until a few days ago when one of the firm engineers was sent for and, although the governor has been benefited a great deal, it is not yet where it should be because it allows the engine to speed up when the load is light, although governing very satisfactorily while the load is normal. All that was done was practically the same as had been followed by other engineers who had undertaken the job of fixing the governor, that is, alteration of the spring. In this case the outside spring was discarded entirely and the spring in the dashpot was removed and a heavier one, made of tempered steel, substituted in its place. This spring was constructed so that when the governor was running in its regular position the spring was under tension of so many pounds. This together with moving the weight further out on the lever were the only changes made. This goes to show what small things sometimes cause considerable trouble, worry and annoyance.

There is one thing that should be noticed, that is, that the contrary to what we are taught and led to believe was employed in this case, as the governor should always operate free with nothing to retard its motion, while we see here that the spring, placed in the dashpot accomplishes the opposite of this as it retards the downward movement of the lever and weight. W. S. Graves.

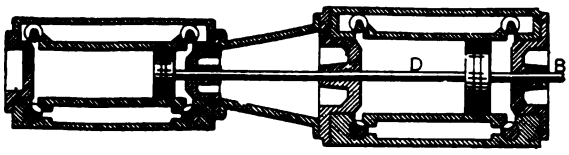
Piston-rod Packing.

Editor of the Engineers' Review:

Every engineer is doubtless aware that of all the engine room supplies receiving the least attention through the columns of engineering journals is that of piston packing. There is no supply which receives more condemnation from engineers, or more energetic effort on the part of the manufacturer, who strives to make a piston packing which will be satisfactory both as to wear and price.

Piston packing is a necessity which was born with the introduction of steam into the steam cylinder of an engine and there are few specialties used in engineering practice which show a greater diversity of opinion and ideas of construction, material employed, or the way in which they are arranged. Yet all manufacturers are striving to reach the same result, economy and durability. Times have changed materially since the engineer was obliged to use the hemp or flax packing for about every conceivable purpose in the engine room. These changes have brought a demand for a rod packing which will fulfill the conditions imposed by high piston speed and high steam pressure.

Many ideas have come to light which were crude, but nevertheless useful. Each new idea has served its purpose, if only to show the necessity of overcoming a weak point. The engineer at the present time is not satisfied with the conditions of the past and the varying conditions under which packings are used.



SECTIONAL VIEW OF HIGH AND LOW PRESSURE CYLINDER.

Much trouble could be avoided in regard to piston packing, if the designers of steam engines would combine and adopt a general rule for providing stuffingboxes of ample size and depth, giving each packing an equal advantage. Every engineer knows that the selection of packing is decided upon by the type of engine on which it is to be used. He must learn to know the difference between good packing and the cheap product which looks nice but has very little wearing qualities. When an engineer finds that a certain packing is satisfactory it is quite difficult for anyone to convince him that another kind is better or even as good.

There are some conditions where even the best packing fails to bring about satisfactory results. One example is in the stuffingbox of some tandem compound engines. Engineers who have had experience with this type of engine have doubtless noticed that the stuffingbox on the crank end of the cylinder nearest the crank has a tendency to leak steam to a greater or less degree and doubtless they have been puzzled more than once as to the reason for it. It seems almost impossible to secure a packing which will prevent this leakage. When the matter is once taken up for investigation, the reason of a leaking stuffingbox is quite apparent.

The illustration shows the sectional view of high and low pressure cylinders of a Corliss engine together with the piston and rod of each. As a general thing it will be the stuffingbox *B*, which gives the greater amount of trouble from leaking steam. If the cylinders are reversed and the high pressure cylinder is next to the crank, the result is just the same, the same difficulty being experienced in keeping the piston-rod tight.

An examination of the pistons of such engines will show that in the cylinder, whether it be the high or the low, which is located next to the crank, it does not fill the cylinders as close as it might, space being allowed for a free and easy movement of the piston. The main trouble is caused from this condition because this allows the piston-rod to spring, supporting as it does, the heavy piston of that cylinder, the rod having practically no support between the crosshead and the piston of the low pressure cylinder *D*.

It has been found that if the piston of the cylinder *D*, is made to fit snug, or nearly so, that this springing of the piston-rod will create an undesirable knocking, which would doubtless cause the ruin of the cylinder in a short time. For this reason the piston is made smaller than that in the head end cylinder and the knocking is avoided. The piston rod is also prevented from becoming crystalized from these sharp and sudden knocks. This springing of the piston-rod is what makes it almost impossible to keep the stuffingbox *B*, tight. Another reason is because the stuffingbox clearance is more than in the average stuffingbox on a single cylinder engine. We have just put in a new kind of metallic packing in the crank end stuffingbox of our engine which seems to be doing what is claimed for it and we are awaiting the result with considerable interest as it promises to be a packing which will fill the bill. We have found that no kind of soft packing that we have been able to buy as yet will keep the stuffingbox tight and at the same time keep the cost of packing anywhere within reasonable bounds. A. E. Akers.

Be Honest.

Editor of the Engineers' Review:

I notice a great deal of difference of opinions expressed in the Review in regard to deception in engineering and I for another do not think any form of deception in the business is right. Deception is deceit any way you look at it and most of the human race detests deceit. In every case there is some honest way of getting out without any deception on your part. Tell the truth about all things and then if the proprietor or the man higher than you cannot comprehend, it is his business and not yours. If you have fulfilled your duty you are not to blame. John L. Rucker.

Don't Deceive.

Editor of the Engineers' Review:

The writer has carefully read the many letters in the Review's columns on the subject of deception in engineering practice. We are credited, by the majority of our fellow men, as a class of intelligent, studious workers, and if we wish to merit a continuance of the good opinion of the public, we must certainly remain strictly honest in our practice. There may be cases where it might be admissible to deceive the factory hands, as to steam pressure, temperature, etc., but the employer has a right to know what is going on and should be taken into our confidence. In one particular should we be careful, and that is in writing articles for the Idea Exchange. The Review seems to be particularly fortunate in keeping up the character of this department. Some papers, however, permit articles to be published describing apparatus that exists only in the fertile brain of the writer, who is writing for so much per column, and who does not care if his scheme works out or not. Some one will try these "fakes" and disappointment is the inevitable result. This breeds a lack of confidence which results in many really valuable hints being disregarded. An editor must have a head longer than a hoe handle to discriminate between the articles, judging whether they are the result of patient experiment and actual trial or simply "deception." Do you see the drift of this, boys? The success of the Review, which mirrors in a large degree the success of our profession, was certainly not obtained by deception. Confidence in ourselves which is closely allied to self deception, must not be confounded with it. Self deception is some times the most dangerous of all forms of this evil. Let us, at least, eliminate all forms of deception from the columns of our engineering journals.

Engineer.

Deception.

Editor of the Engineers' Review:

I have been reading the articles that appeared in the magazine, under the heading of Deception.

I was employed in a large steel plant when I discovered an attempt at deception which might have resulted disastrously to some of the men in the engine room. It happened like this: A 250-horsepower Ball engine had been keyed up during the day, and the night man, not aware the engine had been shut down, took no more than usual notice of it. The engine (which, by the way, was an enclosed type running in oil) became extremely hot on the guides, which were cast on the engine frame; the engineer slowed down so that the engine was just turning over when he notified the chief engineer, who seized a cold water hose and turned it on the guides and cracked the upper one by the sudden contraction. He then endeavored to cover up the crack by filling it with cable dressing so the master mechanic could not discover the break.

The chief engineer's idea was to let it break on the other man's shift.

Such deception is very dangerous, and is only done by a coward and a sneak. Such practice should not be tolerated at any cost and cannot be too strongly condemned. Martin Roskay.

Does Not Have to Deceive.

Editor of the Engineers' Review:

I see in the Review that the engineers are talking of deception. I do not think deception is right, but I don't say we are all clear. I am working for a man who is an expert boiler and engine man and I don't have to stoop to deception. I have worked for men who knew little about engines or boilers who I may have deceived some.

When it comes to using hard or steel plugs for safety plugs that is going a little too far.

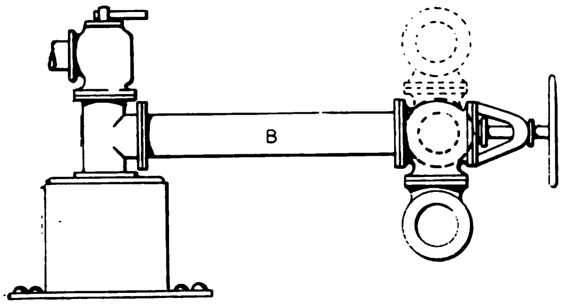
S. H. Hawkins.

Valve Connections.

Editor of the Engineers' Review:

The letter by "Turbino" in the April issue, asks for criticisms on the plan of piping shown in the illustration, where the valve connection form a pocket in both instances. I do not favor either method of piping. In the connection made as shown by the heavy lines, a pocket may be formed. In the instance of the dotted line a bad pocket is formed, because the water of condensation will settle between the valves and the tee connecting with the dome, until a sufficient quantity has been stored to be raised by the steam as it passes on to the engine.

A better way would have been to have turned the valve at right angles to its present position as shown by the heavy dotted lines and have the pipe run at right angles to the pipe *B*, the heavy dotted lines showing the flange which should connect with the flange on the steam pipe. In this way the formation of a pocket would be avoided and one elbow, at least, would be eliminated from the pipe line.



WHICH WAY SHALL THE VALVE BE TURNED?

As to the method of connecting several safety valves to one escape pipe "Turbino" wants to know if boiler insurance inspectors do not notice such arrangements. It is certainly bad practice, and it does not seem that an engineer should wait until an inspector came around and condemned the arrangement before changing it. If the pipe connecting the different safety valves is of such an area as to be capable of handling all the steam that could possibly blow from all of the safety valves at once, the arrangement might be considered all right, but it does not appear that such is the case and it is very doubtful if it is. A. E. Ludlow.

Pipe Repairs.

Editor of the Engineers' Review:

The experiences of others related in the Review has been very interesting to me, and I desire to furnish a little to the general fund of information along with others.

Perhaps the manner in which I overcame a difficulty in a piece of piping will be of interest to the readers, especially to those who are located at a distance from a machine shop or placed where pipe fittings cannot be obtained easily. In this case the pipe *A*, Fig. 1, developed a leak at the point where it entered the coupling *B*. There was no union about the place and the pipe had to be used all the time.

After taking the pipe out and laying out another the same length, I cut a long thread on one end, while the other was threaded as usual. The long thread was screwed into the coupling as far as it was necessary by springing the pipe sidewise in order to allow the end *C*, to face the elbow. It was then screwed into it by back turning on the pipe until the joint *C*, was tight. Then the nut, which was made out of a coupling sawed in two and the ends filed square, which had been placed on the pipe *A* before it had been screwed into the coupling, was screwed up tight against asbestos wicking which had been wound in between the coupling and the nut.

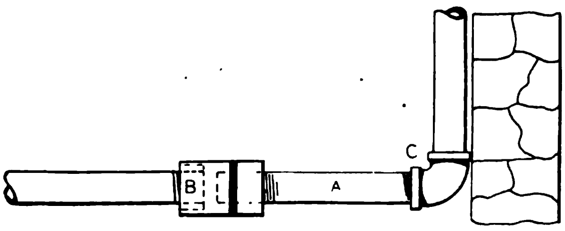


FIG. 1. LONG THREAD JOINT.

Another way to have fixed such a pipe would have been to have put a right and left hand coupling at *B*, threading the pipe right and left hand. This could not have been done in this case as the elbow *C*, was against a stone foundation and would not spring enough to allow the pipe being sprung in between the elbow and the coupling. Neither would the pipe running in the other direction give any, so it is evident that the right and left hand thread could not have been used.

Fig. 2 is another instance in which the same method was used in making a joint where it was impossible to get the proper fittings to work with. In this instance the pipe fitted into a flange coupling on one end and into a tee on the other. I have found this method of repairing pipes to be of great value to me in several plants.

The letter by "Saw Mill," page 17, of the March issue, relative to the handhole plates on boilers and the trouble he has experienced regarding the threads of the studs burning fast to the nut, reminds me of the trouble I used to have with the same thing. I overcame the difficulty by mixing a thick paste of ground asbestos and water, and plastering it over the nut and thread of the stud. The asbestos was secured in place by wire to prevent its falling off after the fires had been started. This method prevented the nut from burning onto the stud, and unless I neglected to wipe

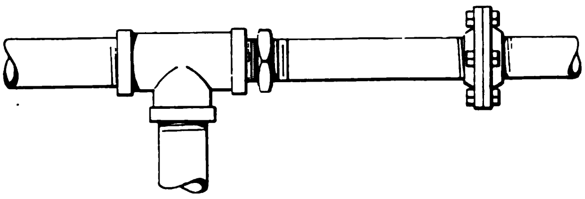


FIG. 2. ANOTHER WAY OF USING THE LONG THREAD.

the stud with graphite and oil, there was little trouble about the nut starting when I wanted it to.

I have had cases before trying this method of protecting the nut, where it was necessary to split the nut in order to remove it. I have known of engineers twisting the stud off rather than be bothered with trying to remove the nut without hurting the thread. Of course they had an extra plate on hand and were not delayed while a new stud was being placed in the old plate. W. B. Rudd.

Firing Necessary to Success.

Editor of the Engineers' Review:

I never attempted to write for any of the engineering journals, although I have often been tempted. I yielded to the temptation when I read P. F. Turner's letter on "Gear Grease." Mr. Turner is right when he says a gear will last longer without grease than with it. I have had a number of years' experience with traction engines, and have tried different kinds of grease. I have lubricated one side well and run the other side without any grease, and I am convinced the best results are obtained from using no grease at all. If I were to use lubricants I would use a good grade of cylinder oil.

Grease will collect dirt and grit and fill up between the teeth, making the gears run hard.

Edward C. Kennedy is O. K. on the shaking grate. According to my opinion they are the only grates to use. All a fireman has to do, is to use them as they were intended, to shake out the ashes and clinkers, and not the fire and coal.

I see "Whiskers" has quite an elevated opinion of his ability as a fireman. I think I can fire a little myself, but I can't fire without making smoke, although by taking pains, excessive smoke can be prevented. I think the reason why W. E. S. can't see any smoke from his boilers when they are in use, is because he is in the engine room and can't see the top of the smoke stack. I have never seen the stack yet that did not throw out some smoke, no matter how the boilers were fired.

In T. E. C.'s letter it is hard to tell just what he thinks in regard to the necessary experience required of a man to act as a fireman, in order to be a successful engineer. He thinks a man will make a better engineer by saving firing expenses, and he winds up by saying that it is not necessary for a man to be a fireman to be successful. I can as well believe that a man can become a college graduate without first learning his A B C's, as to believe that a man can become a successful engineer without having had experience as a fireman. The boilers are the lungs of the steam plant (so to speak), and if the fires are not kept in the proper shape and the necessary pressure in the boilers, I would like to know how T. E. C. is going to keep his engines going. He may study the principle of firing until he is gray headed, but he can't step down in the boiler room and force a boiler without experience.

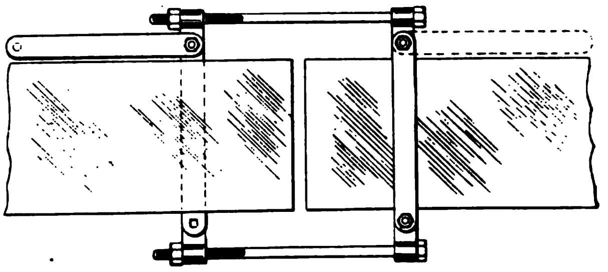
The chief engineer has charge of all those under him, fireman included, and what they lack in knowledge he is supposed to supply. If the firemen don't know how to fire with economy and keep their fires in proper shape to hold steam, I can't see how the engineer is going to show them, if he doesn't know how himself. I have worked with this kind of chief engineers, and I know that my experience as a fireman has saved us more than one shut down.

I don't think there are very many machinists who make successful engineers. The worst failures I have even known were men that served their time as machinists. In my opinion life is too short for the average man to master two trades. I have worked at the business for 20 years and by the time I have mastered the engineering profession, I don't think I will have any time to learn the machinist trade. The engineer who tries to do his own repairing necessarily neglects something else. Slim Jim.

A Belt Clamp.

Editor of the Engineers' Review:

The accompanying illustration shows a simple belt clamp, and about as convenient a one as I have ever seen. The dimensions given are for nothing over a 12-inch belt. The clamp is made of ½-inch by 2-inch iron for belts not larger than 12-inch in width and ⅜-inch thick. If larger belts are to be clamped the dimensions of the material must be increased accordingly. The side bolts are of ⅞-inch stock and 24 inches long. The bolts clamping the cross pieces are made of ½-inch stock and are 2½ inches long. They should have square heads.



BELT CLAMP.

To take the clamp off, slacken up on the long bolts and then on the small bolts, and take two of them out. When a larger belt is to be clamped, the above clamp would not be large enough as the cross pieces would probably spring in the center and allow the belt to slip. New Beginner.

Thinks it Foolish Stuff.

Editor of the Engineers' Review:

I wish you would discontinue sending the Engineers' Review as I do not want it, as it is all made up by the editor, someone who knows nothing about engines or boilers. That can be seen by such foolish stuff as will be shown by the letter which I enclose. (The letter enclosed was one clipped from the Review, entitled, "Experience with Water Tube Boilers," and will be found on page 13 of the January issue.) Any man with half brains knows that the water leg of a water tube boiler cannot be stopped up as the letter says, as the back side of a water leg has no ground joints and the castings are very rough, just as they come out of the sand.

I have two water tube boilers, a Babcock and Wilcox and a Root, and if I find one leaking my helper and I take the old tube out and send for a boiler-maker, and as we keep a few tubes on hand we are all ready for him when he gets here. In three hours, all told, the boiler will be as good as new and tested with 100 pounds water pressure, so you can see newspaper talk does not go with me. I do not know it all and I never claimed to, so please discontinue my journal, as I cannot afford the price. Philip Dase.

[We feel that we owe our readers in general and the many intelligent engineers who have contributed to this department an apology for publishing the above letter. We would ignore it entirely were it not for the fact that Mr. Dase doubts the veracity of one of our contributors who is entitled to some consideration.

Mr. Dase very modestly confesses that he does not know it all. But is his confession necessary? Engineers who are familiar with the different types of water tube boilers need not be told that. It is self-evident.

As Mr. Dase mentions the B. & W. boiler, we think it fitting to state that the operation mentioned by Mr. Privott can be performed on one of the types of that very boiler. Perhaps Mr. Dase did not know that all B. & W. boilers are not built alike and that the various other makes of water tube boilers are not patterned after the Root or the type of B. & W. that he operates.

That part of his letter in which he states that all the letters in this department are written by one man, would be amusing were it not a pitiful exhibition of his ignorance, and a reflection upon his own ability and engineering knowledge.

We are sure that none of our contributors, most of whom are men of wide experience and occupy positions of trust and responsibility, will feel aggrieved at any of Mr. Dase's statements.

Any engineer wishing more information regarding the letter entitled "Experience with Water Tube Boilers" can address Mr. V. V. Privott, Lexington, N. C.—Editor.]

The Efficiency of Boiler Joints.

Editor of the Engineers' Review:

The recent explosion of a boiler in Massachusetts brings up the question of the strength of boiler seams when they are not weakened by cracks or other defects. I presume there are at least a few readers of the Review who are not familiar with the methods used in computing the strength of a boiler seam. It is not only interesting to ascertain the percentage of strength of a seam, but many times it will show whether it is safe to operate a boiler at a certain pressure. The boilers which I have charge of are triple riveted seams of the butt joint type with inside and outside straps. The boilers are 66 inches in diameter, thickness of shell $\frac{7}{16}$-inch, having a tensile strength of 60,000 pounds. The diameter of the rivets are ⅞-inch, and the rivet holes are $\frac{15}{16}$-inch pitch. The pitch of the rivets in the outside row is 7¼ inches.

There are two ways of figuring the efficiency of such a joint. The first is to determine the strength of the net section of the plate between the rivet hole which will be 7¼ minus $\frac{15}{16} = 6\frac{5}{16}$. $6\frac{5}{16} \times \frac{7}{16} = 2.76$ square inches of metal in the net section of the plate. If the metal has a tensile strength of 60,000 pounds, we have 60,000 x 2.76 = 165,600 pounds tensile strength of the net section of the plate. The strength of the original plate corresponding to the above will figure out $7\frac{1}{4} \times \frac{7}{16} = 3.17$ square inches section of the original plate. At 60,000 pounds tensile strength, the result would be 60,000 x 3.17 = 190,200 pounds, the strength of the original plate. Dividing 165,600 by 190,260 = 87 per cent as the efficiency of the joint by the above calculation.

Another way to figure the efficiency is that calculated upon the basis of the strength of the rivets to resist shearing. Such a joint gives a unit section containing 4 rivets in double shear and one rivet in single shear. The rivets when properly set and filling the hole have a diameter of $\frac{15}{16}$ inch corresponding to an area of .69 square inch. The total shearing surface will then be .69 x 9 = 6.21 square inches. A safe shearing strength of rivets has been estimated as 38,000 pounds to the square inch. This would give 235,980 as a total shearing strength of the rivets in the portion of the joint having a length 7¼ inches equal to the pitch in the outside row of rivets. When this is compared with the strength of the solid plate as calculated above, it would seem that the rivets are stronger than the solid plate, and consequently stronger than the net section of the plate between the rivet hole in the outer row, therefore the plate is the weaker point and should be used in computing the efficiency. For this reason it will be seen that the joint would have an efficiency of 87 per cent. This may be a surprise to some to know that the rivets are of a greater strength than the solid plate, but such is the case. This is also evident from the photograph, No. 3, shown on page 45 of the April issue, where it will be seen that the rivets have held in the longitudinal joint, while the plate gave way.

I. G. Manley.

Handling Boilers.

Editor of the Engineers' Review:

The article describing the giving away of the bagged plate of a boiler recently, opens up a wide field for discussion pertaining to the license law of engineers and ought to convince every engineer that a license is a necessity.

I am not writing this to condemn inspectors or criticise their work. There is no doubt but what they are doing a great deal of good, and many times force the owners of steam plants to make repairs that never would be made otherwise.

There are some men capable of handling boilers who could not pass the examination, because they are unable to express what they do really know, but they are few compared to the many who are wholly unfit to bear the name of engineer. There are some that are good men with an engine who know nothing about the care of a boiler, and that is why I claim all men should be licensed. For instance if the chief should be a man of this sort and the fireman know nothing about a boiler only what his superior told him, and there are hundreds like this, there would be trouble sooner or later.

Let me cite an instance of incompetence. Boiler No. 1 was under steam and it was desired to cut in boiler No. 2. A fire was started and after the chief had told the fireman of the danger of cutting in, he was convinced that the fireman was not used to such work and told him to leave it and he would do it. A few hours afterward stepping into the boiler room to see how things were coming on, he found the safety valve of No. 2, just rising steam at 100 pounds and No. 1 at 65 pounds with the fireman coming from the top of the boilers where he had been cutting them together with this remark, "I tried to catch her before she blew off, but couldn't." I would like every engineer and fireman who reads this to ask himself if he would be willing to go up on top of the boiler carrying 100 pounds of steam and throw an 8-inch valve wide open into a boiler carrying only 65 pounds, and yet this man did, and with no bad results. Don't misunderstand me in this, I don't mean that this could not be done, even with safety, providing it is done carefully, but never open hastily any valve leading from a boiler.

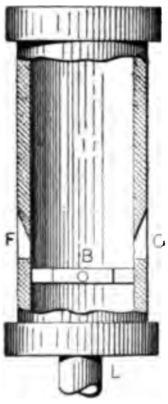
M. E. Webber.

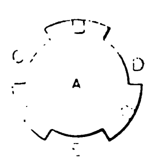
Homemade Whistle.

Editor of the Engineers' Review:

In one plant where I worked we had no whistle and consequently there was no general way of notifying the workmen when to begin or leave off work.

The machinery was often left on when shutting down, thus making it hard for the engine, when it came time to start, to get over the center without giving it an excessive amount of steam. I found in the repair shop a piece of 4-inch brass pipe 1 foot long, and constructed a whistle as shown in Figs. 1 and 2. A center piece *A* shown between the two whistle sketches, was turned out of a piece of brass and three holes drilled in it as shown. The disk was fitted into the whistle, as shown at *B*, Fig. 1. Pins were run through corresponding holes in the tube to those in the disk, which were then cut off even with the outside of the pipe and firmly soldered. Three sides of the disk had previously been filed away as shown at *C*, *D* and *E*, to provide for steam passages. Above these passages, and in line with them, three rectangular holes were filed, as shown at *F*, *G*, in the brass pipe or whistle body. On the upper side, the edges were filed down as at *H*, thus forming a sharp lip. Round disks were fitted to the top and bottom of the pipe as shown, the bottom one being drilled and tapped for the steam pipe *L*. This made a very good whistle that could be heard, even if it wasn't up to date.





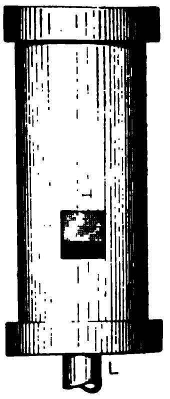


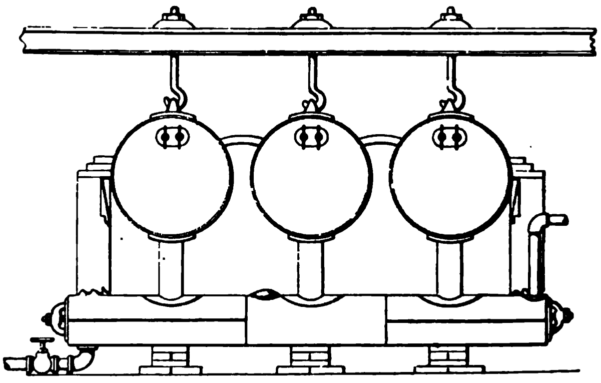
FIG. 1. SECTIONAL VIEW. FIG. 2. WHISTLE COMPLETE.

D. O. Crawford.

Thinks Air Caused the Bulge.

Editor of the Engineers' Review:

On page 29 of the March number of the Engineer's Review, F. H. asked for the cause of the bulge on the top of his mud drum. I think the cause is air collecting, which forms a pocket and so prevents the water from coming in contact with the plate. It probably came in with the feed water. It is evident that something must be done immediately as the pocket will grow.



WHAT CAUSED THE BULGE?

C. E. Bome.

Boiler Inspection.

Editor of the Engineers' Review:

From what I can judge from the letters written by engineers and published in our old favorite, the Review, not much is heard from this part of the wild and woolly west.

In the February number of the Review quite an extended article was published on the letting go of a bag in a patch on a boiler located in Cleveland, Ohio, which resulted in the loss of two lives. The matter was also taken up editorially.

In my opinion the editor is somewhat at fault in criticising the boiler insurance inspector so severely in this case, as this bag developed in the patch after his inspection, and if he or his company were not notified they would have not been the wiser until the next inspection, if the bag had held that long, which unfortunately it did not.

Boiler insurance inspectors are often lax in their duty in many cases, I will concede, and in my experience I have known them, time after time, to visit plants where I was in charge, make an external inspection, maybe test the gage and maybe not, make a few inquiries and go away not to return for another three months. I believe that inspectors knowing the character and ability of an engineer depend a great deal, in fact more than they ought on him, expecting information from him if everything is not working properly. Every engineer in charge of insured boilers, if he does not feel secure, should call for a thorough inspection on the next visit of the inspector, and there is no question but that it will be made.

In the case of the Vulcan Building boiler, the patch bagged after the visit of the inspector, and was not reported, I presume, and the engineer probably would not ask his employers for a shut down of that boiler for

v patch, fearing the loss of his position, if he re-
to keep a fire under it in that condition. Em-
rs as a general rule, don't hesitate long between
ling the safety of employees and an increase in
tbook. They take the pocketbook.

e consider the engineer at fault and believe him
nsible for the loss of those two lives. The minute
ag was discovered in the patch he should have
ed the fire pulled and the boiler cut out and re-
d it to his employers, refusing to put it in service
a new patch was put on, and if they saw fit to
im he could leave such a murderous outfit, know-
ie had done his duty, even if it did cost him his
on. Better lose a thousand positions for doing
duty in such cases than to cause the loss of one
rough failure to take proper precaution to guard
n safety.

Minn. Chief.

was not the intention of the editor in the editorial
ioned to score the boiler inspector because of the
although the bag was present upon his last visit
e boiler room when the boiler was under repair.
was told the editor by one of the firemen. The
ism we had to offer was that nearly a year had
d after the inspector had recommended that the
be retubed, before it was done, which was only
two weeks before the bag gave out. We do not
der the engineer to blame, considering the fact
ie was new to the plant and had plenty of trouble
ng it running at all. It is quite likely that a piece
aste was left in the boiler by the boiler maker
i was not removed when the boiler was closed,
ausing the already bagged plate to bag more, re-
g in the accident. [Editor.]

Boiler Inspection.

r of the Engineers' Review:

ave read with much interest your article, as well
ur editorial in a recent issue, concerning the acci-
to the steam boiler in the Vulcan building, Cleve-
Ohio.

is evident from the facts you quote that the
s were being operated in an apparently unsafe
tion, and undoubtedly the authorities will be able
ice the blame on the right parties.

u take the opportunity in your articles to censor
oiler inspectors, notably so, the inspectors em-
d by the insurance company. Being employed in
apacity of an inspector myself by one of the
inent insurance companies, I desire to express
iews on the subject.

is evident that the boiler in question was patched
ly over the fire. The patch having become
d from deposit collecting over it, the pressure
oo much for it to withstand, and consequently it
go" with fatal results. Personally, I have never
ated patching, and where patches are employed I
rs advise the substitution of an entire new sheet
place it, providing the condition of the boiler in
al will warrant this expense, if not I reduce the
ing pressure commensurate, with existing condi-

Invariably this plan meets with vigorous pro-
from the owners, resulting in considerable cor-
ndence between the owners, the insurance com-
and the inspector. If the inspector "stands pat"
gh all of this fusillade of paper bullets, the
es are the insurance is cancelled. Then in all
probability some minor repairs are made and later on some "special" agent is sent from another insurance company who writes the risk, and this particular boiler passes into the care of another inspector and having the same conditions to meet and overcome as the previous one, he unfortunately gets the worst end of the argument.

As far as the insurance companies and their inspectors are concerned, there is no law which they can use compelling the owners of steam boilers to make repairs suggested by the inspector. We can only advise, not compel. The only thing we can do, is to cancel the policy when conditions reach a dangerous point, but what becomes of the boiler later? Who inspects it when we condemn it?

I maintain that in all cities, there should be an inspection law in force, and the city boiler inspector should make regular inspections, independent of the insurance companies, for the reason that the city inspector would have the law back of him compelling repairs, while as I have stated, insurance inspectors have not. I have in mind numerous cases I could quote where my personal judgment has been condemned, resulting in the loss of business for my company, because I "stood pat," and all in the state of Ohio.

I will quote one case in particular for your information, this instance being in the eastern part of Ohio, where I was to inspect a boiler in a coal mine. In making my regular internal examination I found the bottom sheet of one of the boilers so badly pitted, bulged and fire cracked, that I advised putting in a new sheet without delay. After personally showing the defects to the general manager, he agreed with me, that it was necessary to do something and he verbally agreed to substitute a new sheet. He also promised that this should be done in 60 days. In the meantime as another means of safety, I reduced the stipulated pressure 10 pounds, then I made out my report, along the above lines, which was duly forwarded to the assured.

During this time the manager of the coal company found that to effect the repairs required, meant reduction of dividends. So he wrote to the company by whom I was employed, that as he considered my judgment in error, he had decided not to make the repairs which I advocated. The company wrote me to that effect and asked if the matter could be held in abeyance, to which I simply replied, no. The result was we cancelled our policy, and for aught I know this boiler is being operated in the condition noted, endangering the lives of the employees and the neighborhood, and there is no law to compel that company to make these needed repairs. This is only one case in Ohio.

Your editorial suggests that the boiler inspection be placed under the jurisdiction of the state examiners of steam engineers. To this I will say that this body seems to have troubles enough now, without adding more responsibilities to their office. The law under which they grant licenses has a good deal to do with the accidents which are taking place so frequently, from the fact that they issue licenses to men who are wholly incompetent to care for steam plants properly. If the laws under which examiners of steam engineers grant licenses, were so amended that it would not be possible for the second, third and fourth class licenses, and only license men of skill and mechanical ability, it is probable that the boiler and engine rooms in the state would be supplied with a better grade of engineers and the boilers would have better care.

A steam boiler is a dangerous apparatus even when well taken care of, but when neglected as I regret to say, a great majority of them are, they become a menace to the neighborhood in which they are located.

In regard to patches on boilers, I wish to state I have known of patches remaining intact for years and others I have known have failed in a few days. What I would like to see is a law enacted in every state in our great Union, making it a criminal offense, punishable by imprisonment for boiler owners to operate patched boilers. Until inspectors have a lever of this kind to use, all the laws put in effect regulating the operation of steam boilers will be a failure.

John Annal.

Bagged Plates.

Editor of the Engineers' Review:

The letter by "A Crank" on page 17 of the March issue opens up a question which has been discussed but little in the Review or any other paper that I have taken during the last five or six years at least. The question is setting up bags on steam boilers. It seems to me that a discussion of this question by engineers who have had experience with bags would be to our mutual profit, for there are not many questions around the boiler room which have a greater or more vital interest to the fireman and engineer. The result of a bag giving away as illustrated in a recent issue of the Engineers' Review is only one of the proofs of the above statement.

I have never had very much experience with bagged plates on boilers, in fact the only case I had was in a plant where one boiler was patched and the other boiler had three bags on the fire plate, two of them, however, were nothing more than very slight bulges while the third was down about an inch and a half and came down with very gradual easy curve. Such a bag as that might possibly be forced back into shape, but when it comes to some bags that I have seen, my idea is that they should be cut out entirely.

When a plate becomes so heated that the pressure in the boiler is sufficient to force it down, the strength of the plate must have deteriorated to a considerable extent, and even though the bag is forced up into its place again, that part of the metal has become weaker and therefore a source of danger.

This reasoning may be entirely wrong and if so I am perfectly willing to be convinced otherwise. The proper and the safer way is to cut the bag out and patch the boiler, although we all know that a patched boiler is not as strong or desirable as one which is not, but it is preferable to having a bag honeycombed with holes, forced back into position and the holes afterwards plugged, as advocated by some.

One thing is evident, a bag should be forced back into position so that the inner surface will be convex rather than concave as this will prevent the lodgment of scale in that particular place, the circulation of the water in the boiler tending to keep it away.

The same thing might be said of a patch, that is, the patch should be placed on the inside of the boiler rather than on the outside. If it is not, it forms a pocket for scale which usually finds its way th

I heartily agree with the answer to question which says that "if a bag is of such proportion a necessitate the drilling of a hole in order to forc back in place, it had better be cut out and the p patched."

I would like to hear what other engineers hav say on this question, which has so much to do with safe operation of the plant. N. Lyma

Carelessness and Ignorance.

Editor of the Engineers' Review:

Your editorial in the March issue on the neces of vigilance calls to my mind several instances of c lessness or ignorance which may be interesting. Th incidents are as follows: In a certain plant the t sheets are braced, as shown in Fig. 1. *C* is the sheet of the boiler, and *B* is the tube sheet. On amination it was found that the bolts *A*, were with nuts and several of them had worked upwards u they were as at *D*, in Fig. 2. The pressure on head had bent them as shown.

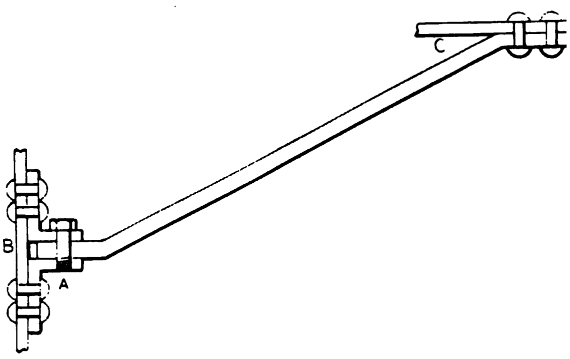


FIG. 1. BRACE AND BOLT IN POSITION.

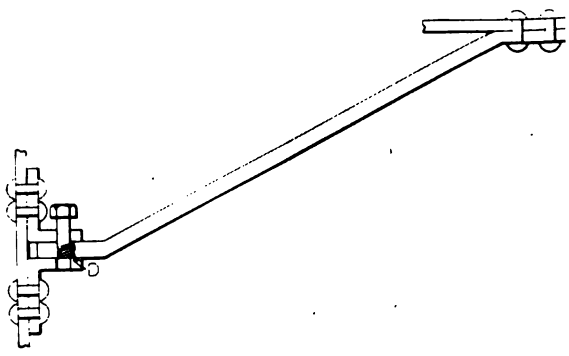


FIG. 2. HOW THE BOLTS WERE FOUND.

Another plant had a boiler which had been in o ation several years. Suddenly the front tube started to leak very bad. The boiler was exami and found perfectly clean and not burned from water, but in the inquiry it was brought out that fireman was in the habit of having the smoke doors open all night, and had been doing so for sev years before the flues started. The boiler must b

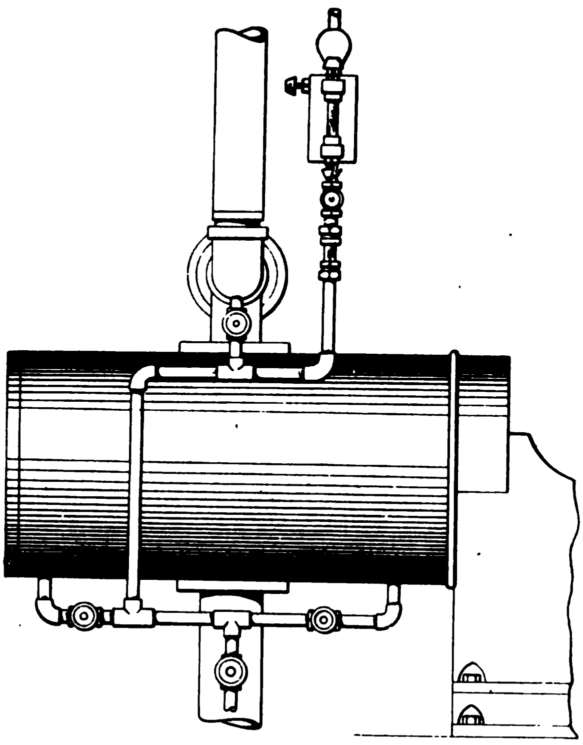
:xceptionally good one to stand the strain as
: did.
fireman was engaged in another plant, and
'st day there was trouble. He had been in-
to shut the main steam valve at 6:30 p. m.
as he did so, the water started to lower in
. He at once opened the main valve again
ıined things and soon found that there was
valves on the returns. As soon as he closed
valve the pressure forced the water out of
· and up into the steam pipes, unless a num-
ılves on the returns were closed. I believe
check valves on the main return now.
st case was in a factory where there was a
f a steam pipe which caused a lot of damage.
scovered that the man in charge had no idea
hange the tension on a pop valve, and had
› carry a higher pressure of steam than at
: valve was set. He was a genius so he simply
up the outlet of the valve with a cast iron
ıis happened several years ago, so let us hope
.s wiser by this time. Jimmie.

Lubricator Drip Pipe.

the Engineers' Review:
gh much has been said about lubricators and
connections of late, I wish to call attention
le idea that saves a lot of spilt water on the
·ell as the necessity of keeping a can or other
to catch the water, when the lubricator is
reparatory to filling.
ngine the bleeder pipe is tapped into the steam
the lubricator is piped up as shown in the
n. In order to avoid the trouble of running
nsed water into a can, I piped the drip out-
lubricator to the bleeder pipe. Now all I
ıbout to fill the lubricator, is to open the small
:he ¼-inch pipe leading from the lubricator
p pipe and the water runs into the drip and
away without any bother or mess on the
ɔm floor.
r to know when the water is all out of the
and the oil is going to waste, I placed in
ı with the pipe a sight glass, just beneath
:ator. This glass was taken from an old
and the end holes plugged up. The end
:ach stuffing box was drilled and tapped for
pipe. The job when completed looked as
the illustration.
found strange conditions existing in other
engineers who were in the habit of writing
l articles for engineering papers, on what the
gineer should and should not do, when the
demned was being practiced by the author
icle.
nber one time feeling that the engineering
ɔuld be enlightened upon the responsibility
ɔsition, and how essential it was to always be
okout for trouble and of the necessity of
ilant and wide awake while on watch, and
allowing a newspaper or any other thing
·e with the performance of their duties.
icle had not been printed when I got a hot-
e engine through too close adjustment and
ıttending to it after the adjustment had been
ɔrtunately I caught it in time to avert any

damage but it was through the sense of smell rather than vigilance on my part.

It was not long after the production was published in one of the engineering papers, that I fell asleep in my engine room one afternoon after eating a hearty dinner. No harmful results came from my nap, but



PIPING OF LUBRICATOR DRIP.

it was not following out the instructions I had so impressively given the "younger engineers" to follow. Of late years I have been content to take advice from others rather than attempt to give it. I sometimes think "young engineers" know more than the engineers who are telling them what should and should not be done. H. R. Hatch.

Soot as a Nonconductor of Heat.

Editor of the Engineers' Review:

"Motor," on page 20 of the April issue of the Engineers' Review, makes a few comments on a letter published in the January issue by C. Garman, who, among other things spoke of the "non-conducting property of soot." "Motor" says he believes that when soot lies in the bottom of the tubes of a boiler without sticking to the top or sides, it does little harm, as the sides and particularly the top are the main heating surfaces of the tubes "the bottom being of very little practical value."

If such a condition could exist, that is, the soot lying on the bottom of the tube and no where else, I could agree with him, but I have yet to see an instance where the soot in the tubes of a return tubular boiler stuck to the bottom and no where else. My experience in this line has been, that the tubes as far as I have been able to judge have practically as much soot on the top and sides of the tube as on the bottom, the only difference being that one kind of coal will make more soot than another. I have yet to operate a boiler where the soot will be deposited upon the bottom of the tubes and no where else.

"Motor" says that the sides and top are practically the main heating surfaces of the tubes, the bottom being of very little value. As he does not give a synopsis of his reasoning in arriving at such a conclusion, the readers of that portion of his letter will, I think, wonder why such deductions have been made. We know in the case of boiler rating, that so many square feet of heating surface are contained in the tubes, and that one part of the tube is figured as having just as efficient heating surface as another. It is true that the question has often come up as to whether the bottom tubes radiate as much heat to the water as the top tubes, the contention being that the upper tubes radiate the more. This deduction is arrived at from the fact that the old charred stick experiment seems to prove this to be so.

This is an experiment which has been tried by different engineers and consists in placing a stick lengthwise in front of the middle row of tubes, so that there is space for the hot gases to pass each side of the stick. After the stick has been in position for a few moments, upon being removed it will invariably be found, that the stick is charred the most opposite the upper tubes, while the end opposite the lower tubes will be but slightly charred in comparison.

Experiments that have been carried on by engineers, myself included, has given rise to a belief that the upper tubes do not convey the most heat to the water, but that the lower tubes do. The supposition that the gases passing through the lower tubes at the front end of the boiler are cooler than the gases passing through the top tubes at the front end, is due to the fact that the more heat has been taken from the bottom gases than from the top. Of course this is a question which is easily disputed and hard to prove.

The same principal, however, enters into the case of the top and bottom of the tube as a medium of conducting heat to the water in a boiler. In the case of the upper and lower tubes, the contention is that the upper tubes contain the hottest gases, from the fact that hot gases rise while cooler gases take the lower position. I presume this is why "Motor" maintains that the top of the tube does more work as a heating surface than the bottom, but I hardly think the difference in the temperature of the gases passing through the bottom and top of a 3 or 3½-inch tube will amount to very much.

If hot gases take the upper position in a passage it is quite evident that the flame hugs the boiler shell as it passes to the rear connection, and as it reaches the end of the boiler it curves up and enters the top tubes. At the same time cooler currents of gases are flowing in the same direction, but underneath the hotter gases, toward the rear connections, where being hotter than the air and gases in the extreme bottom of the combustion chamber, naturally rise and pass into the tubes. Before the cooler gases can get into the tubes, however, they must mingle with the hotter gases, and in mingling both gases become of the same temperature, the cooler gases becoming hotter, and the hotter gases become cooler. In this state they enter the tubes.

If the current of hot gases as they pass through the tubes was in one continuous straight line as a person would stretch a cord from one end of the tube to the other. "Motor's" contention might hold, but there is everything to indicate that the current of air is not in a straight line. Observation has shown that the current of gases passing through the tubes is that of a spiral nature. This can be observed by opening the flue cap after a fresh fire has been put in the furnace, and observe the twisting or spiral motion of the smoke as it comes from the tubes.

The same theory is well illustrated in the editoria "Flooding Engine Cylinders" in the April issue where it shows that water in moving towards a commo center at which it escapes, does not move in a straigh line, but approaches the outlet in spiral currents. I seems to me it matters little whether the flow be tha of water or gas. The same result will be the outcome.

If "Motor's reasoning is correct and mine is wrong why is it, if the greater part of the available hea rises to the upper portion of the tube, that the so would not do likewise rather than fall to the botto of the tube? Of cou [illegible] soot is heavier than ho gases, but neverthele [illegible] accumulates in such fine particles that accord [illegible] laws it should follow the path of the [illegible] and attach itself to the top of the [illegible] according to my experience it does [illegible] sides and bottom.

[illegible] B. Douis.

Bill B. Bang [illegible]

Editor of the Engineers' [illegible]

Mr. Editor and other suf [illegible] casion or rather sit down to w [illegible] tions regarding the tramp enginee [illegible] has been written during the past 5 [illegible] which I see has held some space in th [illegible] help support by my subscription. Most [illegible] blers warble long and loud in their praises [illegible] cess which attends the tramp engineer, in his [illegible] around the country. He is pictured as never [illegible] in anything he sets out to do. He always comes around in the nick of time and saves the ever faithful, but ignorant engineer, from humiliation and disgrace, by advancing his valuable and timely advice which he has picked up here, there and other places.

How we would ever get along without the tramp engineer I don't know. When we read the lives of great men, we have got to admit that the most of them were on their uppers, some time or other. Napoleon went on more than one tramp (after his horse had been shot from under him). Our departed President Garfield tramped many a long day along the towpath of a canal. Of course the civilized world could have gotten along without these two illustrious men, but without the hobo engineer, never! He has been created for the express purpose of demonstrating that he is it. He is sure to come around just when wanted and tell you how to manage your plant in a manner becoming a practical engineer. He can drop into a plant 30 minutes after it has been started and tell the engineer who has been hanging out there for 10 or 15 years, just where all his troubles are and what they originate from.

The hobo engineer is known by the company he keeps and has a distinguishing air of his own, like all other noted people. You can tell him as far as you can see him. His hat is brown and greasy, his hair is loaded with clinkers of an earthy composition which have accumulated because of the non use of water and a clinker-bar of soap. He usually goes without a collar or tie, with the top button of his shirt gone, and his vest buttoned up with two or three buttons while the remainder are either hanging or missing. The drippings of his last bowl of soup from the free lunch counter are still upon his vest, his coat is out at the elbows, his pants are baggy in the knees and frayed at the bottom and his shoes run down at the heels. By these marks may he be known.

Before I go any farther, I will make the statement to be sown broadcast throughout the world, that I ain't got any more use for a hobo engineer than a dog has for a skunk. I have seen too many come in and try to show off what they know, or didn't know, and they always leave a bad taste in a fellow's mouth after they are gone. I had one fellow come in one night and as it was pretty cold I told him he might sit down and toast his shins by the cylinder of the engine. Then I went about the plant looking for trouble as usual. When I came back that jay had his hobnail shoes up against the polished cap of the cylinder head, and the scratches are there today. You can bet the last cent you've got that he didn't stay there very long. When he told me not to worry about a little thing like that, I just told him that worry was as useless as it was to tell people not to worry. I also told him that when a man resists a tendency as a general thing the other fellow don't regret the fact, and my tendency was to kick him out.

At another time a hobo who owned a gold mine in the shape of engineering knowledge, but was fool enough not to work it, came in and gave a lot of advice about this and that. After he had gone I found a streak of tobacco juice dried onto the polished cylinder-head cap.

It was only a few days ago that one of these fellows came into my engine room while I was sitting at my desk and, although it was raining hard outside, he didn't even know enough to wipe his feet on the mat at the door; but made tracks clear across the engine room. The first thing he said was: "Say, are youse de guy what runs dis push?" I told him I calculated I was if any one did, and asked him what he wanted. "Well," says he, "De first thing I wants to tell you is dis, your engine's out of whack, she's on de bum, see, and dat goes." By his talk I knew I was up against a tough proposition, but just then Tige poked his head out around the desk unbeknownst to the tramp and began making googoo eyes at him enough to raise his hair if he'd seen him. "What do you know about engines?" says I. And I felt a little bit cheap when I come to think of all the time I put in fixing that engine up, only to be told that it was on the "bum." "Know," says he, "I've engineered in every state in de Union and what I don't know about engines, ain't worth knowin', see. I'm de guy as can put one together in de dark and takes a back seat for no man." Just about this time Tige had sized him up and concluded he wasn't desirable company and gave a low growl as a sort of invitation to git. The hobo looked around, and although he had boasted he took a back seat for nobody, he did make a few side and back steps and disappeared through the door, regardless of the rain which was coming down in something beside the gentle spring shower.

HE DIDN'T EVEN KNOW ENOUGH TO WIPE HIS FEET.

No, fellows, I don't like tramps and when I get stuck, I would rather go to some one that I know, knows more than I do, and I am pretty sure to get what I want. About the only thing that class of men do, is to try to get a living without work, but they are sure to work harder and get a poorer living than if they did an honest day's work for an honest day's pay. Them is my sentiments which I intend to hang on to and let my hair grow. Bill B. Banger.

Engineers vs. Engineers.

Editor of the Engineers' Review:

The letter by T. E. C. on "Engineers vs. Firemen," has suggested a letter under the above caption as it seems to open up a field for discussion equally as broad as the other. It isn't a matter of firing with most engineers, but a question as to whether they are competent enough to operate, as they should, the machinery under their charge.

I know many instances of engines being run continuously 24 hours, necessitating a double shift, where the chief engineer is not nearly as competent as the assistant, and only holds his position through a pull with the head men. Perhaps engineers east of the Mississippi are of a different character from others, but probably there is not much difference. The following is an illustration of the condition of affairs out here. In a plant near my own, they run with a day and night shift. The chief engineer to my personal knowledge cannot set the valve of the duplex pump. This was shown by the condition in which it was operating when another engineer took charge of the plant for a few weeks during the illness of the chief. When the pump had a tired feeling and stopped as it did when the steam pressure went up to 90 or 100 pounds, it was given a kick by some employe and started going again. The new man after adjusting it had no further trouble.

The chief is very self-conceited, and never gives out any information regarding the plant to his assistant, consequently one never knows what the other's intentions are. It seems to me that most anyone can see that under such conditions the plant cannot be run as it ought.

I know of another instance in a plant operating day and night, where the engine was run for several weeks with a broken piston which was known to the chief, although no word had ever been mentioned regarding the matter to the assistant.

In my opinion the chief engineer should allow his assistant to know all the details regarding the condition of the machinery which is under his care during the night shift. He has no opportunity for finding out for himself, as the chief would naturally insist upon doing, or superintending all repairs. I do not believe that anything is lost by allowing two heads to think and decide regarding questions relating to the steam plant operation. If the chief does not allow his assistant to know the different details of the plant, it is suggestive that he is not sure of his ground, and is afraid that the assistant with the same knowledge regarding the plant would be a better man, and one who would be a menace to his position.

R. W. Diefendorf.

The Duties of an Engineer.

Editor of the Engineers' Review:

The letter by F. S. Jenkins, on page 37, of the March issue, is to my mind about what the "doctor ordered." It is evident that there is an impression among engineers and employes that in order to hold a position they must be busily employed around the establishment, doing odds and ends of all description, while the employer, seems to think that the engineer should be on the jump from morning to night, and if he isn't, takes it as a proof that he is not earning his salary.

I have had some experience with this kind of engineering and therefore see the injustice that the engineer is doing the employer as well as the injustice the employer is doing the engineer. If an engineer is kept busy around the shop from morning until night, it stands to reason that he will not have much time during working hours to attend to the wants of the steam plant, in the manner of repairs and keeping it in a proper condition. Neither will he be inclined to put in very much over time, using the argument that, if his employer does not care enough about the plant and its condition to allow him to put his time in there, attending to his own work rather than that of someone else, it is little moment to him whether the plant is kept up in proper shape or not. Consequently the needed repairs are neglected, and in a short time the machinery and other apparatus become run down and uneconomical.

Under such conditions it will not be long before the employer begins to complain of the additional operating expense entailed and begins to wonder why. He doesn't seem to remember or awake to the fact, that the reason is because his nose is so long that he cannot see past it and that if he persists in causing conditions to exist, which do not permit his engineer putting in the time necessary to make the operation of the plant successful, that the engineer is not going to lose much sleep over his end of the game.

I recall an instance where the engineer was of a nervous make up and it seemed impossible for him to set down five minutes at a time. He would no sooner get in his chair when up he would jump to feel of a bearing, or squint at the lubricator or some other little thing about the engine room. Then he would return and set down only to jump up again in a moment and rush to the fire room, yank open the doors of the furnace and putter around a while and then return to his chair, only to repeat the same operation time and time again. This was while he was in the engine room, other times he was employed around the factory sweeping floors and doing other miscellaneous janitor duties. The proprietor of the establishment thought he had an A No. 1, engineer, who earned all the money he got, simply because he was on the move all the time.

As it happened I went to operate the same plant shortly after he got through. I took charge the first thing in the morning, and although the plant was new, by 9 o'clock I had assured myself that everything was going to operate in a satisfactory manner. In looking over the cupboard I found an interesting novel, which I was soon absorbed in with my chair tilted back against the fire pump and my feet cocked up on the desk and this was the position the proprietor found me when he suddenly came into the engine room, and a more surprised looking man I never saw. After the first glance at me he looked at the engine then at the steam gage and passed out through the engine room with nothing more than a nod of greeting. That was not the last time he saw me reading and although he entertained the idea that an engineer should work around the factory doing odd jobs, I gradually weaned him from these notions and when I left the plant four and one-half years later, it had been some time since I had gone out of the engine room to do outside work.

In another plant I went to, such conditions did not exist. The proprietor of the establishment being perfectly satisfied to have an engineer who was competent and who would keep the plant up so it would keep the wheels revolving six days and six nights every week. He seemed to realize the fact that an engineer to do justice to his work should devote his time to the steam plant and to nothing else, and I will say that he, in my estimation, had the right idea, and by allowing me to attend to my own affairs in the engine room I took more interest in the plant and I know that money was saved in the operation because of this.

I have never yet seen the man who could do two things at once, successfully, although the contrary has been said of woman. I do not believe that an engineer can operate his plant as successful, when he is trying to do the work of two men as he would, if he were attending to his own business and letting the other man take care of his. There are some problems about steam engineering that require thought and investigation which cannot be entered into when the engineer is occupied scrubbing floors, etc. The old adage that "All work and no play makes Jack a dull boy" can be applied even to steam engineering.

Wm. A. Holcomb.

Lap Joint in Boilers.

Editor of the Engineers' Review:

In all probability the Brockton boiler explosio which was so fully illustrated and described in th April issue of the Engineers' Review, furnishes a much, if not more ground for comment and discu sion than any boiler explosion that has occurred for a good many years.

The cause of the explosion was without doubt due to a fractured plate along the longitudinal seam of the boiler and one that could not be detected by the ordinary means of boiler test unless it is the hydrostatic, which might or might not have brought it to light. Being an engineer in the state of Massachusetts, in the vicinity of Brockton, this explosion naturally strikes home deeper than if it had occurred in some foreign locality. I have read in several engineering papers articles regarding the explosion, but the "Review" has the best report of the matter, both in text and illustrations and confirms, more closely, the data which I have collected from various sources, than any other journal. I notice you state in your editorial the lesson to be learned from this disaster is that a law should be passed in every state prohibiting the use of boilers of this type. I agree with you in a measure and especially your statement that it is difficult to pass such a law, because of the apathy among the masses who know little of engineering matters.

Just how many years the lap joint boiler has been in use probably no one knows, but it is safe to say that it has undoubtedly been the cause of many boiler explosions. It is no more than fair to say on the other hand, that probably as many causes for boiler explosions have existed in other parts of the boiler. I for one do not think it is feasible, practical, or even necessary to prohibit indiscriminately, the use of boilers constructed with lap joints, but I do believe it would be a wise law that would prohibit the use of lap joint boilers over 48 inches in diameter. The legislature of Massachusetts is now considering bills, which in my opinion, are radical in some of the provisions for safety in the use of steam boilers in this state.

Since the Brockton explosion three bills have been introduced, one of which will if passed positively prohibit the use of lap seam boilers. The essential features of the bill are as follows: No boiler constructed with lap joints shall be installed in the future; lap joint boilers over 15 years of age shall be retired from service within 1 year, and boilers less than 15 years of age shall be put out of commission within two years, after the passage of the bill. In my opinion the passage of such a law will meet with strong opposition, although it will have the support of public sentiment for the time being, at least. If this law should be passed and put into operation, without amendments, it will condemn the greater proportion of boilers in use in this state.

The portion of the bill relating to the further installation of lap joint boilers, is a good thing, as it will not be a hardship for any one, or cause a monetary loss. There are very few who will think it just, to compel the man who has installed a new boiler of the lap joint type, 48 inches in diameter, or under to throw it out and buy another, without some measure of protection.

It will be a question hard to decide, and just why the bills should indiscriminately apply to all boilers of this type, is where the opposition will arise.

From some of the editorials, in other engineering papers, one would form the opinion that the great loss of life was caused directly from the boiler explosion itself, while in reality it was largely due to the collapse of the building, which pinned the unfortunates down in the debris where they were unable to escape the flames, communicated to the building, probably from red hot bricks.

Engineers who are familiar with the construction of Massachusetts shoe shops know that if the building had not collapsed as a result of the explosion and the weight of a water tank full of water on the roof, the loss of life would doubtless have been greatly reduced, and perhaps confined to the engineer alone. I take this ground because the engine and boiler room were not located in the factory but in a separate building, the force of the explosion being directly away from the factory. It would not be a bad idea for the legislature to investigate the way in which shoe factories are constructed, which is of as much importance, as the passing of a law prohibiting the use of lap joint boilers.

I notice in your report that the district attorney is quoted as saying that if any one is morally responsible it would seem to be the man who devised this particular style of boiler. It would appear to others that if any one is responsible it is the man who bought the lap joint boiler, when he could have got a butt joint boiler at a little more expense.

In boiler making as in other business, the manufacturer produces what is demanded. If a firm demands a cheap boiler, it will be made for them. If a good boiler is desired it can be obtained by paying the price.

The lap riveted joints are as yet indispensable in the construction of boiler shells, and I do not believe they are as dangerous as many would attempt to point out, in boilers under 48 inches in diameter, where they are receiving proper care and attention. For boilers over this size I am heartily in favor of abolishing the lap joint. A Massachusetts Engineer.

How the Regulator Works.

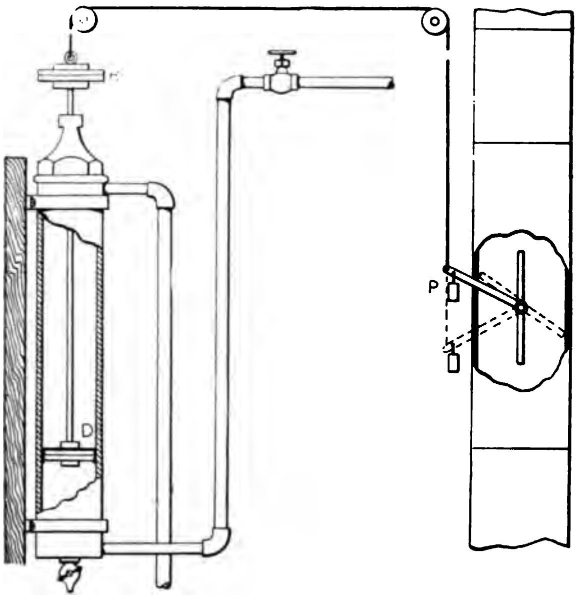
Editor of the Engineers' Review:

In reading over the April issue I notice that H. S. C. wants to know how L. A. Cole's damper regulator worked. I don't know how Mr. Cole's damper regulator worked, but I know how one operated which I manufactured for a plant I was operating some time ago. The firm did not care to buy one, and the one I made gave satisfactory results. The steam pressure, however, was not kept as constant as it could have been with a regulator purchased from a reliable manufacturer.

The way I would explain the working of such a damper regulator is as follows: The weights *B*, on the regulator piston are adjusted so that a certain steam pressure in the boiler will just force the piston up. It will be found that with say a pound more pressure, the piston *D*, will be forced to the top of the cylinder, thereby closing the damper, or nearly closing it, as I preferred to have some draught on all the time, which prevented the fire from getting dead. This works better than allowing the damper to close entirely, because the steam would drop 4 or 5 pounds after the damper was open before the fire burned bright enough to raise steam.

Supposing 80 pounds was the pressure desired to be carried, the weights on the piston would be adjusted so that the piston would begin to rise at 79 and reach the end of its stroke at 80 pounds. If the damper operates easily, as it should, and there is no friction more than is absolutely necessary between the damper and the damper plunger, the weights on the plunger rod will gradually force the water in the plunger cylinder back in the pipe, when the pressure has fallen below 79 pounds.

With my regulator the difference in pressure between opening and closing the damper was between 5 and 6 pounds. I did not find it necessary to have provision made at the bottom of the regulator for the escape of water, although if this had been arranged, doubtless it would have been more sensitive. A damper somewhat similar to Mr. Cole's and the one I refer to, will be found on page 10 of the July issue, 1903, of the Engineers' Review.



MR. COLES DAMPER REGULATOR.

I think this way of making the regulator is preferable to the one Mr. Cole invented, as there is less liability of the piston-rod becoming sprung, due to the weight, as it requires about 40 pounds of weight to balance 80 pounds steam pressure with the size cylinder used, the larger the cylinder, the more weight will be required. A Governor.

Smokeless Stokers.

Editor of the Engineers' Review:

I noticed in the February issue of your paper under the heading "Smokeless Firing" and signed W. C. Bosworth, the following paragraph: "As to an absolutely smokeless furnace, even with mechanical stokers, I have my doubts that such a thing was ever claimed, even for the best of them, because when a boiler is forced hard, the stoker cannot be made that will prevent the formation of smoke."

If by "absolutely," he means one that never under any circumstances emits smoke from soft coal, all must agree he is correct. The "best of them" will smoke when fires are being built and, momentarily, at other times when unusual conditions prevent for the time being, the regular operation as designed. But I wish to call attention particularly to the assertion in the latter part of that paragraph. I could take W. C. Bosworth, where there is more than one make of one of the type of stokers he mentions that frequently force the boilers 50, in some cases, nearly or quite 100 per cent beyond rated capacity without there being any smoke.

It is a fact, but not as generally known as it should be, that the most economical, most durable and satisfactory stokers are also the most efficient in preventing smoke, and will, when properly proportioned, crowd the boiler very strong—stronger than it is possible to crowd with hand fired furnaces, and efficiently prevent the formation of smoke.

I personally witnessed a forcing and smoke test on three boilers, 66 inches x 18 feet, and containing 54, 4-inch tubes each. This test was of ten hours' duration and an average of 600 horsepower per hour was developed from the three boilers. The "log" showed that for one hour, the third, there was 674 horsepower developed, and the report by Prof. Carpenter of Cornell, who had charge, said there was no smoke. Certainly those boilers were "forced hard." This occurred several years since, and not 100 miles from Cleveland.

I recently witnessed a capacity test on a boiler said to be 600 horsepower, but which was really only about 500 horsepower, on a fair rated basis. This boiler was equipped with two stokers of recent design, and these were run so as to feed all the coal the ½-inch draft of the stack would burn. The coal used was second grade Pittsburg slack. The consumption was a little over 10 tons in eight hours, and 740 horsepower were developed. Surely that boiler was forced and there was no smoke from forcing.

I could enumerate a score or more of similar exhibitions that prove there has been for years stokers in use that can prevent the formation of smoke when "crowding" or forcing the boilers "hard."

I call attention to these facts because of the very prevalent idea even among those who recognize the superior service of good stokers, that a stoker will not force a boiler or, if it does, it must smoke. The fact is that the best, most economical and most durable stokers are the more completely smokeless, the stronger the boiler is forced, so long as the stoker is allowed to do the work in the way it was designed to operate.

W. C. Bosworth's praise of stokers indicates he is willing to accord merit where it is due, but his article while commendable as a whole, shows the need of more correct information among engineers in reference to the "state of the art." The Engineers' Review can do its readers a service by encouraging discussion along this line. Observer.

Smokeless Firing.

Editor of the Engineers' Review:

I am glad to be informed by "Whiskers" that he has not been asleep like Rip Van Winkle for the past 20 years, also that he is not an old codger.

I can't see that he has changed the situation in regard to the smoke preventing device. It makes little difference whether the thing is operated with an engine drawing the air or by steam. The idea is the same, the result is the same and the failure is the same, and it makes extra work. I have never yet seen one of those steam or wind blowing devices which amounted to anything, because even though they have merits the firemen will soon knock them out, through neglect.

I do not propose to contradict "Mr. Whiskers" as to whether or not mechanical stokers were economical in his plant. He ought to know and doubtless does know, but it does not change the fact that mechanical stokers are economical in other plants, although I have my doubt if such is the case where only one or two boilers are employed. There are plants which can be operated cheaper by hand firing than by mechanical means, and the same can be said of mechanical stokers. There are several conditions which govern the economy of mechanical stokers and if these conditions are not complied with, a mechanical stoker is not economical. Doubtless our friend, "Whiskers" can tell us whether the most economical conditions prevailed where the stokers, he mentions, were used.

"Whiskers" says if it is a fact that making smoke is the fault of the fireman, why not educate the fireman so it will not be necessary to install stokers? In reply to that I will say that it is a difficult job to learn an old dog new tricks. If I were to have my choice of firemen, I would far rather employ a man who had never seen a fire-room, and instruct him according to my own ideas, than attempt to reform the methods employed by a fireman who has been at the work for years. In the one instance the subject is open to instruction. In the other he knows it all, and the case is an exceptional one, where suggestions will be accepted, unless they are given in a manner that admits of no rejection, and then usually they are accepted under protest.

"Mr. Whiskers" evidently doubted my word when I stated that I have operated plants that would show no signs of smoke for hours at a time and the passer-by would not know from the stack whether the plant was in operation or not. "Mr. Whiskers" says he will wager any reasonable amount that he can fire by hand with as little smoke as I can, but he knows he can't fire, without making lots of smoke.

I will modify the statement that I can fire without making lots of smoke by stating that there are some kinds of coal that will make smoke and plenty of it regardless of who does the firing, but when it comes to firing soft coal such as we get here in the state of Massachusetts which we pay from $4 to $5 a ton for, I will say that with the exception of a slight smoke immediately after firing, the smoke problem in my plant is a factor which cuts very little figure.

W. C. Bosworth.

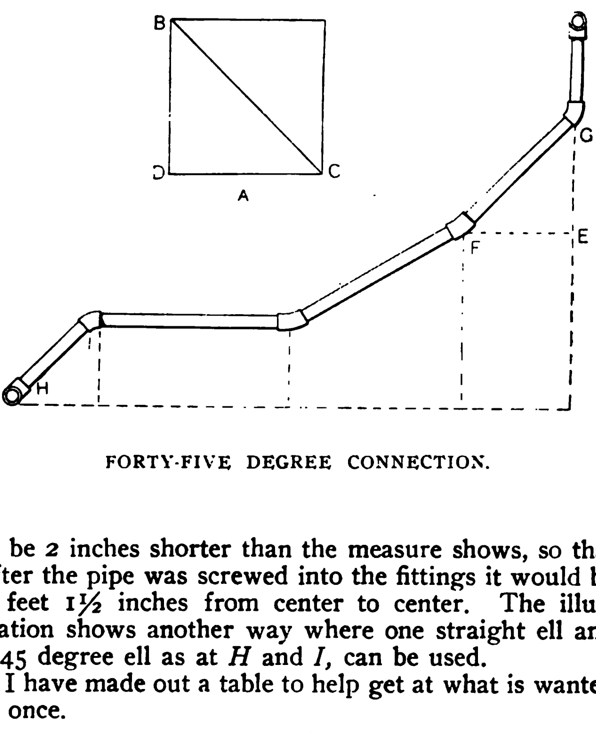
Measuring for 45 Degree Connections.

Editor of the Engineers' Review:

Engineers are sometimes called to take measurements of pipe work for steam or water.

The illustration shows how to save pipe and fittings, also eliminate friction and resistance by using four, 45 degree ells instead of two straight ells. The quickest way to get at an angle of 45 degrees is to construct a square as at *A*. The diagonal line represents the 45 degree angle. Now to make it plain, the diagonal line is just 5-12-inches greater from *B* to *C*, than *D* to *C*, when the square is 1-inch in diameter. In making an offset on a pipe, add to every inch in length 5-12-inch, and to every 12 inches add 5-12 of a foot.

Suppose we wish to cut off the square corner at *E*. Call it 18 inches, 5-12 of 18 inches is 7.5 inches. 18 inches + 7.5 inches equals 25.5 inches. If the dimensions were in feet, the distance would be 25.5 feet, the total length from the center of *F* to *G*. The measurement should be from center to center of the fittings. If the fittings were 1-inch ells, and it was 1½ inches from the center of the ell to the end, and the pipe screwed in ½ inch, you would have to deduct 1 inch from each fitting. Then the pipe *F G* would have to be 2 inches shorter than the measure shows, so that after the pipe was screwed into the fittings it would be 2 feet 1½ inches from center to center. The illustration shows another way where one straight ell and a 45 degree ell as at *H* and *I*, can be used.



FORTY-FIVE DEGREE CONNECTION.

I have made out a table to help get at what is wanted at once.

Table.

From 1 to 12 inches.		From 1 to 12 feet.	
1"	1.416"	1'	1' 5"
2"	2.831"	2'	2' 10"
3"	4.249"	3'	4' 3"
4"	5.653"	4'	5' 8"
5"	7.833"	5'	7' 1"
6"	8.499"	6'	8' 6"
7"	9.916"	7'	9' 11"
8"	11.333"	8'	11' 4"
9"	12.749"	9'	12' 9"
10"	14.166"	10'	14' 2"
11"	15.583"	11'	15' 7"
12"	17"	12'	17'

Referring to the table the first column is for piping from 1 inch to 12 inches. The second is from 1 foot to 12 feet in length.

Frank J. Walter.

Always take the inlet air, for an air compressor, from a point outside the engine room. The cooler the inlet air the higher the efficiency—the warmer this air the greater the loss. It is all the more inexcusable for taking air from the engine room because it is so easy to take air from outside the building.

Engineers' Review

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ELECTRIC MOTOR DRIVE.

It is not until attempts are made to enumerate the different purposes for which electric motors have been utilized, that it becomes apparent to what extent electric power has been adopted. Probably the greatest use of the motor for power purposes has been applied to the machine shop in the form of individual drives for lathes, planers, etc. The portable electrically operated tool is used to a far greater extent than many are aware of; in fact it is being used for nearly every conceivable purpose.

Among the latest uses to which electric motors are being put is that of portable tool heads which may be fastened to a stand and easily attached to construction work, requiring drilling. Less time is required to use the tools in this manner than would be necessary if the work were placed on a horizontal boring mill.

The advantage of such a device to the engineer is obvious, particularly when it is necessary to rebore a cylinder, or do any other job of that nature.

STEAM PLANT AUXILIARIES.

While considerable thought is usually given to the selection of engines and boilers for a steam plant, the auxiliaries receive only secondary consideration. A chain is as strong as its weakest link and it matters not how efficient the main part of the plant is, or how well adapted to the conditions under which it operates, the highest economy will not be obtained if the auxiliaries are improperly arranged or are not suited for their work.

Special attention should be given to the selection of condensers, circulating pumps, feed pumps, feed water heaters, storage batteries, etc., for each has a certain duty to perform and its failure to do that duty may cause disaster to the plant. The selection of a condenser was discussed in the May issue of this publication.

Each of the various methods of driving feed and circulating pumps, have its advocates. Doubtless steam driven pumps are more satisfactory than any other, and are most in use, although electrically driven pumps have given good results and are employed in many of the largest central stations. The successful operation of a pump driven by electricity depends largely upon the type and power of the motor. If the motor has been selected by guessing at the size and type required, there is apt to be trouble. The motor should have a capacity of at least 25 per cent more than the full load power actually required by the pump in order to be sure of satisfactory results. In computing the power of a motor for pump service, a friction loss of 10 per cent should be added to the power required to lift the water. The power necessary for a particular size of pump may be roughly estimated by calculating the net power required to lift the water and deliver it, to which should be added 10 per cent of this value.

Boiler feed pumps as well as condensers should be well regulated as to speed, and under the immediate control of the man in charge. Doubtless as good speed regulation can be obtained with motor driven pumps, as with steam driven pumps, but spasmodic operation should not be permitted in either. Although many engineers believe that motor driven pumps can not be controlled as to speed, as well as the steam pumps there is no reason for thinking so.

Probably no part of the average steam plant produces a greater saving for the money invested than a good feedwater heater. Here, to, type and size play an important part in the operation of the apparatus.

The storage battery is coming more and more into general favor as station men realize the advantages to be obtained by its use in taking off the peak of the load or even taking the whole station load at times when it is very light. Recently the storage battery has been used as an auxiliary to the exciter plant in alternating current generating stations. This application of the storage battery is a most efficient safeguard against a shutdown, and by its use steam driven exciters are not necessary.

QUESTIONS
·OF THE HOUR·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.
The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

(428) E. M., DeQueen, Ark. Q.—"Is there any special rule for determining when the system in a compressor ice plant is properly charged with ammonia. The condenser is double piped and the receiver is horizontal?" A.—As far as the type of condenser is concerned it makes no difference and has no direct bearing on the question. Any type of condenser, atmospheric double pipe and submerged can be used, provided capacity enough is supplied to properly condense the ammonia gases delivered by the compressor. The amount of piping or capacity varies with the efficiencies of the respective types. The atmospheric being the most efficient, the double pipe next and the submerged type least of all. All three types give good results and efficiency must be sacrificed for convenience, etc., in many cases. As for the receiver, it has of course a direct bearing on the question, as capacity must be provided for storing a certain reserve amount of liquid ammonia when pumping down, transferring and making repairs, etc. The rule used by representative engineers is as follows: To fully charge a compressor system with ammonia that will give best results, allow ⅓-pound of ammonia per running foot of 2-inch expansion pipe in the system, and the same for the discharge side. That is, find out how many feet of 2-inch pipe you have in the system, and divide it by three and you have the amount of ammonia in pounds that you should charge into the system. Unfortunately this amount is seldom placed in the system, as only in few cases, has capacity been provided by the builder for this amount. More plants are operating with ¼-pound than are those with more, but even this amount gives excellent results. A receiver should be vertical and have sight glasses on it, with automatic shutoff cocks. This shows the height of the ammonia in the receiver at all times, when running, and enables the attendant to see whether the ammonia is running low or not. A system is fully charged and doing good work, all other things being equal, when you have a reserve amount of say 50 pounds (as a minimum), of ammonia left in the receiver, after every foot of expansion coils are fully frosted back, or nearly back, to the compressor, and the condenser pressure corresponding to the proper operation of the plant, and the back pressure, or suction pressure, is at a point corresponding to the temperature ordinarily carried in the cold storage rooms, or to the brine temperature in an ice plant.

(429) F. McN., Franklin, La. Q.—"I have a tank 10 feet in diameter and 35 feet 3 inches long. How many gallons will it hold?" A.—To find the cubic capacity of a cylinder in gallons, multiply the area of one end in inches by the length in inches. This product divided by 231, the cubical contents of U. S. gallon in inches, will be the capacity in gallons. Thus we have $10 \times 12 = 120$. $120 \times 120 \times .7854 = 11{,}309.76$ inches. The length equals $35 \times 12 + 3 = 423$ inches. $11{,}309.76 \times 423 = 4{,}784{,}028.48$. $4{,}784{,}028.48 \div 231 = 20{,}710$ gallons, the amount the tank will hold.

(430) W. A. T., Eddyville, Ia. Q.—"In running an electric light plant consisting of an adjustable governor type of engine, and a multipolar compound wound direct current generator with the load varying from zero to full load, would it be best to vary the speed of the engine and leave the resistance in the rheostat connected to the shunt winding cutout, or to adjust the rheostat?" A.—Always operate the engine at its proper speed, and adjust other conditions to it. It would be better to adjust the voltage by means of the rheostat.

(431) Same. Q.—"About what proportion of the output of a dynamo over compounded 10 per cent would pass through the shunt winding?" A.—The amount of current which will pass through the shunt winding of a dynamo will vary according to the size and speed of the machine. A ½ kilowatt machine running at about 1,200 revolutions per minute will take about 7 per cent. A machine running at about 600 revolutions per minute, will take less than 1 per cent of the total output, in the shunt field current.

(432) C. A. W., Basset, Wis. Q.—"An upright engine is piped for drips with ¾-inch pipe at both head and crank end of the cylinder, but have no valve between the two cylinder outlets, which allows the steam to pass from the end taking steam to the end exhausting. About how much loss of power does this cause, with a steam pressure of 105 pounds and the engine operating at 110 revolutions a minute?" A.—You have omitted the most essential item in the figuring of engine power, i. e., the size of the cylinder. We have no way in which to even hazard a guess as to the loss of an engine piped in the manner described. In order to do so with any degree of accuracy indicator cards would need to be taken as the engine is piped at present, and another after the engine cylinder had been piped as it should be. The difference between the power developed, would be the loss from such a method of piping.

(433) J. C. G., Parsons, W. Va. Q.—"A certain plant has a 60 kilowatt alternating dynamo of 2,200 volts and reduced to 110 volts. A wattmeter registers the whole amount of current used. Kindly give data to figure the cost of power at the rate of 5 pounds of coal per horsepower per hour, by the use of the wattmeter, the price of coal being $1.85 per ton?" A.—The cost of a pound of coal at $1.85 per ton would be $1.85 \div 2{,}000 = .000925$ cents. 5 pounds would be $.000925 \times 5 = .004625$ cents per horsepower per hour. A kilowatt, is equal to 1,000 watts and it requires 746 watts to make one kilowatt, which is called an electrical horsepower. 1,000 watts equals $1{,}000 \div 746 = 1.34$ horsepower. The cost of 1.34 horsepower, or 1 kilowatt is .0062 nearly. If you have 150 kilowatt's, the cost of producing them at the above figures will be $150 \times .0062 = .92$ cents.

(434) R. E. K., Green Bay, Wis. Q.—"Will a cement cistern hold water ranging in temperature from 100 to 200 degrees heat. The water is the returns from our heating system? The water will contain some oil from the exhaust steam of the engine. Will

the oil do any harm?" A.—We know of several cement cisterns which are used for the returns and as far as known, there is no reason why a cement cistern will not answer the purpose, provided it is constructed as it should be. It is better to make it round and thus avoid the likelihood of cracking in the corners. The oil might affect the cement in time, but it would be at the water level.

(435) W. N. J., San Marcos, Texas. Q.—"In average practice what is the water consumption per indicated horsepower of the high grade single cylinder Corliss engine of from 150 to 250 horsepower, running condensing, also non-condensing?" A.—As you do not state the initial pressure we will assume that it is 100 pounds, the engine cutting off at ¼ stroke, in which case the actual water consumption has been found to be from 24 to 26 pounds non-condensing, and from 19 to 21 condensing, assuming a mean effective pressure of about 54 and 64 respectively.

(436) Same. Q.—"Under the same conditions what is the water consumption per indicated horsepower of the highest grade compound automatic four-valve engine of from 150 to 250 horsepower, running non-condensing and condensing? Is there any special difficulty experienced in running single cylinder Corliss engines condensing?" A.—A compound Corliss engine of the above horsepower requires from 19 to 21 pounds of steam running non-condensing and from 14 to 16 pounds when operating condensing. There should be no difficulty in operating a simple engine condensing, all that requires to be done is to set the valves with a little more lead and a little earlier compression.

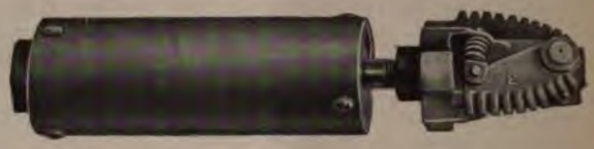
(437) J. W. S., Noringer, Mo. Q.—"I would like to ask which is the most satisfactory way to reinforce an eclipse manhole?" A.—We have never heard of reinforcing an eclipse manhole. There is no occasion for it as it is strong enough without reinforcing. If it is worn out in any way it should be replaced, not reinforced or strengthened.

A NEW TYPE OF WATER TUBE CLEANER.

The tube cleaner illustrated above which is known as the Demon has been designed to clean the tubes of water tube boilers. The device consists essentially of two parts; *viz.* a new form of scale cutting tool and a new and powerful form of rotary motor to drive the cutter. The motor belongs to the general class of rotary engines, a difference being that it has a central shaft and is free from all valves. It bears no resemblance to the turbine motor, either in design or operation.

The Demon is designed to operate by water, the exhaust water being used for washing away the loosened scale. The inlet and exhaust water is taken care of by properly arranged ports. The pistons of the motor, which are three in number, are attached to the shaft, and each in turn automatically projects across the cylinder, thus forming a partition between the inlet and the exhaust ports, which the motive fluid must push forward before it can reach the exhaust ports. As no water can reach the exhaust until the piston has passed the exhaust ports, the water consumed is directly proportional to the speed at which the machine is revolving. When the machine is working on unusually heavy scale, the speed and the water consumption are both somewhat reduced; but the pressure on the piston and therefore the driving force increases. By this means, the shaft is given a constant and positive rotary motion, and the force available for rotating the cutters is several times as great as the pressure of the water supply.

An important advantage claimed for this machine is that a form of cutter can be used entirely different from anything else designed for this work. In the Demon, three cutters with tooth-like edges are attached to a heavy head which is directly attached to the shaft of the cleaner. These cutters are forced out by powerful springs, so that they engage the scale in a positive manner. Their motion on the scale is neither of a chopping nor grinding nature, but that of a direct cutting tool.


THE DEMON TUBE CLEANER.

The outward movement of the cutters is limited by adjustable stops and the cutters can be so set that their outside diameter in their rotary movement is just equal to the inside diameter of the tube which is being cleaned. The motor or body of the cleaner is centered in the tube by six centering lugs, which insures thorough and uniform work by the cutting tool.

The cutters can be easily renewed and at a slight cost. No lubrication is necessary on the shafts. The most approved form of roller bearings made of the best hardened tool steel are used. All wearing surfaces are made as large as possible and of hardened tool steel. The design of the machine is such as to produce a powerful and rapid cleaner and do away with the necessity of frequent repairing.

An examination of one of the Demon cleaners after it had cleaned 15, 140-horsepower water tube boilers showed no appreciable wear on any part of the machine with the exception of the cutters.

This device is manufactured by The General Specialty Co., 73 Carroll street, Buffalo, N. Y.

NEW BOOKS AND CATALOGS.

"MECHANICS OF AIR MACHINERY," by Dr. Julius Weisbach and Prof. Gustav Herrmann, translated by Amasa Trowbridge, D. Van Nostrand Co., 23 Murray and 27 Warren streets, New York, 206 pages, 6 x 9, 91 illustrations, cloth, 1904, price $3.75 net. This volume contains a translation of the portion of Prof. Herrmann's revised edition of the Weisbach work on Engineering Mechanics pertaining to the moving of air, and the final portion of his work. Care has been taken to eliminate as much as possible descriptions of engines or other methods of driving air machinery. The changes made necessary by the introduction of the high speed engine and gas engine are described, also the various kinds of fan blowers that have come into use during the last decade. The subjects treated are, the movement of air; the movement of air by difference of temperature; natural ventilation; artificial ventila-

ctical method and theory; blowing engines of
ypes; compressors; rotary blowers; fans velocity
;n. The appendix comprising 47 pages is devoted
·n American practice.

HINE TOOLS AND WORKSHOP PRACTICE
NGINEERING STUDENTS AND APPREN-
by Alfred Parr. Longmans, Green & Co., 91-93
:nue, New York. 1905. 444 pages, 5½ x 8½, 510
ons, cloth, price $4. This volume is compiled from
of instruction on machine tools and workshop
taught at University College, Nottingham, Eng-
igineering students and others who are mechanic-
ned, will find this volume well worth the price.
ierous branches that the work treats upon, show
t methods of doing things. The volume contains
ers, each one of great interest and value to the
and mechanic. They treat upon the following
in the order given: Measurements; marking out
d processes; materials; drills and drilling ma-
turret lathes; treadle and power lathes; lathe ap-
boring machines; lathe work; grinding wheels
iines; cold iron and steel sawing machines—plan-
ping, and slotting machines; milling machines,
utters and appliances; gear and gear cutters; cut-
s and how to use them; fitting, erecting, vice work
s; forge shop tools, and forging processes; hy-
iachine tools and riveting; transmission of power,
iods of working. The volume also contains an
treating upon measuring machines; sections of
reads; section of union joint; chain wheel and
ving; tables and data.

KENHEIMER'S GENERATOR VALVES," is
of a handsome booklet of 12 pages. By descrip-
illustration the complete construction and advan-
these valves are shown. For further information
he Lunkenheimer Co., Cincinnati, Ohio.

DER OF EIGHT PAGES is devoted to descrip-
nd argument for Pennsylvania metallic packing.
ast few years a great many new packings have
the market, all of more or less merit. As there is
hance for improvement no engineer should lose
rtunity to investigate anything that may prove
lvantage. You can learn all about this packing
ssing the Pennsylvania Metallic Packing Co., 910
Bank building, Pittsburg, Pa.

CREDENTIALS" is the title of a 54-page book-
iining facsimile orders for Williams automatic
r regulators from some of the largest concerns in
try. As many of these are repeat orders ex-
over a period of several years, the inference to be
that the Williams regulator is a pretty good de-
ie Williams Gauge Co., 200 Fourth avenue, Pitts-
the manufacturers.

ALL CALENDAR printed in colors is being sent
dam Cook's Sons, 313 West street, New York.
will be sent to any engineer who writes them.
ipany manufactures Albany grease and offer to
ox of the grease and a grease cup free to any en-
ho requests same and mentions this publication.

FLET describing the Automatic smoke preventer
received from the Automatic Smoke Preventer
lackstone building, Cleveland, O. This device is
to the boiler front and works through a series of
d weights. Full information will be given by the
urers.

MONT" PACKINGS are described in an 8-page
sent us by the manufacturers, Clement Restein &
adelphia. This packing is made in coils, rings,
ctional ring, etc. They also make several other
f packing.

STERLING VALVE RESEATING MACHINE
bed in a folder recently received. It is manu-
by the Sterling Valve Reseating Co., Rochester,

RY ATTRACTIVE BOOKLET is being distrib-
the Wm. B. Pierce Co., 325 Washington street,
N. Y. It is entitled Boiler Room Economy and
the Dean boiler tube cleaner. It will be sent
ny engineer who requests a copy.

TALOG SENT US BY The Johnson Com-
Supply Co., Rochester, N. Y., tells something about Sumac boiler compound which they manufacture. It also contains several pages of facsimile orders for this compound. For further information address the manufacturers.

CHANDLER & TAYLOR CO., Indianapolis, Ind., have sent us a copy of bulletin E-101 which shows their line of enclosed self-oiling engines. This is said to be the first line in the country to be manufactured according to the recommendations of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It is a type particularly adapted to direct connected service.

PRODUCER GAS, ITS USES AND COST" is the title of section 1 of catalog A issued by the Wile Power Gas Co., Rochester, N. Y.

"STEAM" is the title of a handsome catalog sent us by the Aultman & Taylor Machinery Co., Mansfield, O. It tells principally of the Cahall water tube boiler which is manufactured in horizontal and vertical types and the Cahall chain grate stoker.

A HANDSOMELY PRINTED FOLDER describing the steam pumps, power pumps, air compressors, deep well pumps and supplies manufactured by the Weinman Machine Works, Columbus, O., has been sent us. This company manufactures pumping machinery for all purposes.

A BOOKLET describing the transmission rope and belting manufactured by the Ryder Belt & Cordage Co., Buffalo, N. Y., has been handed us.

THE SYRACUSE CHILLED PLOW CO., Syracuse, N. Y., have sent us a copy of catalog No. 12, describing their line of wheelbarrows, carts, etc.

EAST END BOILER WORKS, 25 St. Aubin avenue, Detroit, Mich., manufacture the Detroit water tube and Scotch water tube boilers. The catalog gives nearly all the necessary information.

A VERY HANDSOME catalog entitled "Water Power Equipment," has been sent us by the Wellman-Seaver-Morgan Co., Cleveland, O. This company manufacture several different types of water turbines, and all are well illustrated in this catalog. It also contains a number of tables that may be of value to persons interested in this class of engineering.

"GRAPHITE," the house organ of the Jos. Dixon Crucible Co., Jersey City, N. J., for May contains much matter of interest to engineers. You will do well to write them for a copy. It is free.

WE HAVE RECEIVED a circular describing Hayden metallic packing for air pumps. The N. L. Hayden Mfg. Co., 180 West Locust street, Columbus, O., who manufacture this packing make it also for other purposes. Besides this they have a line of specialties that will interest engineers.

A 175-PAGE BOOK, L 510, describing and illustrating a complete line of steam, electric, gas and power-driven compressors of all types, including single and duplex and simple and compound; single and multi-stage, etc., is being distributed by the Laidlaw-Dunn-Gordon Co., 114 Liberty street, New York city. It gives the results of the latest investigations upon air-valve gears (the most critical feature of an air compressor) and shows a gear combining the quietness, efficiency and high-speed qualities of mechanically-moved valves with the elasticity of poppet valves. It also explains the air lift for raising water from driven or bored wells, gives the amount of air required for pumps and drills, tells how to calculate pipe lines for compressed air, explains the effects of altitude and temperature, discusses the advantages of compounding and intercooling, the advantages of different valve gears for different purposes, the several methods of driving, and gives data on a hundred other things of use and interest to every actual or prospective user of compressed air. The book is a valuable addition to any technical library.

TRADE NOTES.

THE SMOOTH-ON MFG. CO., 375 Communipaw avenue, Jersey City, N. J., offer to send free of charge to any engineer a copy of their new book on how to make repairs with Smooth-On.

THE RELIANCE GAUGE COLUMN CO., 86 East Prospect street, Cleveland, O., manufacturers of high grade steam specialties, such as water columns, high and low water alarms, steam traps, etc., report that business during the past year has been very good indeed. A person visiting engine rooms throughout the country will be impressed by the number of boilers equipped with Reliance columns.

WE ARE INFORMED that the Sterling Lubricator Co., 5 Frank street, Rochester, N. Y., have recently furnished and equipped the entire plant of the Phillips Insulated Wire Co., of Pawtucket, R. I., with the Sterling force feed lubricators. All of these lubricators, except one, were installed on the engines and pumps of the new plant. One of these lubricators was placed upon the engine in the old shop, and the engineer has reported that by its use he is getting a better lubrication with one pint of oil, whereas in the past he has been using three pints for the same length of time, fed through a sight feed lubricator.

IT HAS LONG been claimed that Albany grease furnishes the remedy for all lubrication troubles. Evidence of this is constantly reaching Messrs. Adam Cook's Sons, 313 West street, New York, the only makers, in testimony from users of their compound. In a recent letter received by them from A. H. Smith, of the Smith-Maynard Co., Ralph, Wis., the writer says: "I have thoroughly tested the sample of grease you sent me, and am pleased to say that the results were eminently satisfactory in every way. I have tried it on my most troublesome bearings and they ran as cool as one could wish."

THE ALBANY STEAM TRAP CO., Albany, N. Y., received the following letter from the foreman of the N. Y. C. & H. R. R. Co., of Poughkeepsie, N. Y.: "Would state that I have installed one of your traps in the N. Y. C. round house at Poughkeepsie, on February, 2, 1905, or in other words, I got new fitting for this trap as old fitting was worn out; after getting new fitting on February 2, 1905, trap was started and in checking up the coal used in January, 1905, as against the amount used for 25 days in February I find that we have saved over 66 tons of coal in 25 days, and over 125,000 gal. of water. I think this is a good saving for 25 days."

AT THE ANNUAL MEETING of the stockholders of the Joseph Dixon Crucible Co. the old board, consisting of Edward F. C. Young, John A. Walker, Edward L. Young, William Murray, George T. Smith, Joseph D. Bedle and George E. Long, were unanimously reelected. The board of directors reelected the former officers, namely, Edw. F. C. Young, president; John A. Walker, vice president and treasurer; George E. Long, secretary. Judge Joseph D. Bedle was also reelected as counsel. The stockholders present expressed themselves as thoroughly satisfied with the management of the company by its officers. Of the total number, 7,345 shares, there were represented 7,145 shares.

OILING SYSTEMS may be employed with the same degree of economy upon any size, type, style or number of engines of as small as 50 horsepower and as large as desired. The savings in time, attention, waste, loss of oil in handling, and the neatness with which the engine room may be kept—all this due to the elimination of hand oiling—are advantages which urge the adoption of oiling systems in every modern power plant. Many leading mechanical engineers are specifying the White Star continuous oiling system, and a most noteworthy order recently awarded the Pittsburg Gauge & Supply Co., Pittsburg, Pa., was one for a complete system to be used in connection with 32,000 horsepower of engines in the plant of the Lackawanna Steel Co., Buffalo, N. Y.

THE "NEW YORK SPECIAL" of the Pennsylvania Lines, leaves Cleveland 5:30 p. m., arrives New York 8:15 a. m. A Pennsylvania standard dining car. Through sleepers. Reservations at New City Ticket Office, 112 Euclid Avenue, Colonial Arcade. J. B. Modisette, Dist. Pass. Agent, Cleveland, O.

AT THE ANNUAL stockholders' meeting of the Pittsburg Feed Water Heater Co., the following directors and officers were elected: James Bonar, president; J. E. Schlieper, treasurer; Joseph Cawley, secretary. The pany report business in their different types of h as being good at the present time.

THE BURT MFG. CO., Akron, O., have re shipped one 10-inch exhaust head to the American & Wire Co., and one 24-inch exhaust head to the N Steel & Wire Co., and 120-gallon Cross oil filter National Tube Co., McKeesport, Pa., making 73 e heads and 154 oil filters now used by the United Steel Corporation.

THE UNITED STATES CIVIL SERVICE MISSION, Washington, D. C., announces an exami on June 28, 1905, to secure eligibles from which to certification to fill a vacancy in the position of as engineer (steam and electrical) at the Pine Ridge S South Dakota, at $540 per annum; and vacancies a may occur in the Indian Service, in the engineering tions indicated below. For further information a the Commission as above. Age limit, 20 years o on the date of the examination. Application form only one form being required in case more tha branch is selected.

AN IMPORTANT EVENT in the machinery tra the incorporation, on May 31, of Manning, Max Moore, Incorporated, composed of the well-known of Manning, Maxwell & Moore and its allied manu ing companies, The Shaw Electric Crane Co., The A Mfg. Co., The Consolidated Safety Valve Co., The H & Derby Mfg. Co., The Hancock Inspirator Co., a United Injector Co. The Corporation was formed the laws of the State of New Jersey, and is establis a basis which is unique among commercial enterpr its kind, having a paid-up capital of $5, There is but one kind of stock, known as commo assessable. The officers of the new concern are: A. Moore, President; John N. Derby, Vice-Pre Martin Luscomb, Vice-President; Stephen B. Alle President; Colby M. Chester, Jr., Treasurer; J. H Assistant Treasurer; Charles Arthur Moore, Jr., Sec and Merle S. Clayton, Assistant Secretary. Busine be carried on at the home office of Manning, Max Moore, at 85, 87 and 89 Liberty street, New Yor through their branch offices in Boston, Philadelphi cago, Cleveland, Pittsburgh and St. Louis. With th prestige already gained by the firm and the variou panies, reinforced by the energy, judgment and w quaintance of Mr. Moore and the efforts of the men with whom he has surrounded himself, the suc this new corporation seems to be well assured.

G. U. MERRILL, 31 Van Houten street, Paterson reports the following recent sales of the Merrill Ide strainer: 1, 12-inch to the DeLamars Copper Refini Chrome, N. J.; 1, 6-inch and 1, 2-inch to the A Simon Silk Dyeing Co., Paterson, N. J.; 1, 6-inch Atha Tool Co., Newark, N. J.; same to Benj. At Newark, (second order); same to Underground E Ry. Co., London, Eng.; 1, 12-inch to Balbach, S Co., Newark, N. J.; 2, 14-inch to United Electr Springfield, Mass. (second order), and 2, 18-inch 24-inch to Haverhill Electric Co., Haverhill, Mass.

You Can Save Mon

by using

INTERNATIONAL
Boiler Compound

It will eliminate the danger of boiler explosion reduce consumption of coal. Hundreds of testimo prove its efficiency. We have a special offer to each engineer who will write for it.

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47 Market Street, CHICAGO.

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Price, $4.00 Net.

INTERNAL COMBUSTION MOTORS

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and Prof. H. Diederichs, Sibley College, Cornel University.

⁂

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This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

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We guarantee it.

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Cling-Surface Co
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THE POWER OF THE "DEMON"

is clearly shown on accompanying reproduction of photograph of actual test in which the "Demon" developed a pull of 210 lbs, as against a 5-lb. pull of the turbine when both were supplied by water at the same pressure.

THE "DEMON"
REMOVES ALL SCALE FROM TUBES OF WATER TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/16 INCH OF SCALE
IS 42 TIMES AS POWERFUL AS TURBINE CLEANERS
DOES NOT HAMMER OR GRIND BUT CUTS LIKE LATHE TOOL
CENTERS ITSELF AND CUTS SAME TOP, BOTTOM & SIDES
ADJUSTABLE CUTTER STOPS PREVENT INJURY TO TUBES
ROTARY PISTONS ARE ACTED UPON BY DIRECT PRESSURE AS IN STEAM ENGINE
H-S ROLLER BEARINGS

The "DEMON" is not a turbine, but a powerful rotary water motor which will clean the tubes of your

WATER TUBE BOILERS

more thoroughly than any other machine in the world, and in one-fourth of the time. The "DEMON" is of strong and durable construction and will last for years.

THE "TORPEDO"

is the only perfectly safe and effective device for removing scale from

THE "TORPEDO"
REMOVES ALL SCALE FROM TUBES OF FIRE TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/16 INCH IN THICKNESS OF SCALE
PROLONGS LIFE OF TUBES
SAVES COMPOUND
CENTERS ITSELF IN TUBE
STRIKES SAME IN EVERY DIRECTION
STROKE IS LIMITED AND CUSHIONED
DOES NOT HAMMER BUT VIBRATES THE TUBE
IS ABSOLUTELY SAFE AND EASILY OPERATED
HAS BUT ONE MOVING PART
WILL LAST A LIFETIME

Fire Tube Boilers.

BOTH ARE SENT ON TRIAL BY

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INSURES, AMONG OTHER THINGS

Steady Water	**Less Repairs**
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IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

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The Reliance Gauge Column Co.

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RETURN STEAM TRAP

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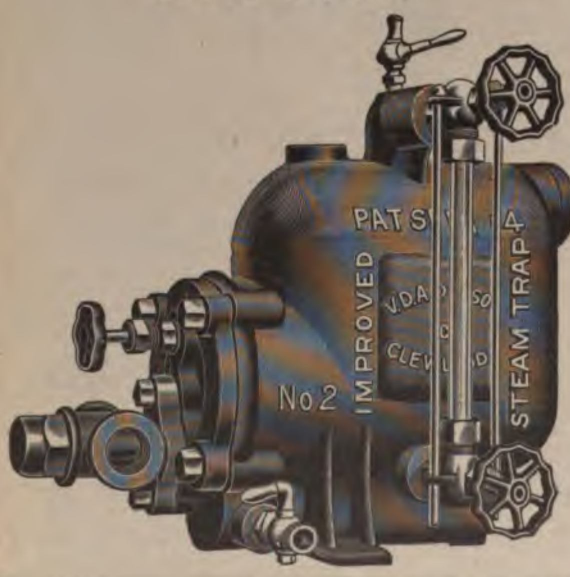

In a Nutshe

"A Wasteless Trap of
Wonderful Capacity"

THE WRIGH
EMERGENC
STEAM TRA

Wasteless because of a **double** w
seal. Note in the cut below that this water se
not a shallow affair, but that it is **constan**
maintained to a depth of four or five in
and covers **both inlet and outlet** of
locking it securely against escape of steam.
charge does not take place until the water fill
trap to about two-thirds full.

Immense Capacity. — We base
claim upon the efficiency of our exclusive three
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with the rise of the float, insure a quicker dis
of sudden flushes of water than any other me
The three valves, or even two of the valves, op
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though it seldom happens that more than the
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Other Advantages, such as eas
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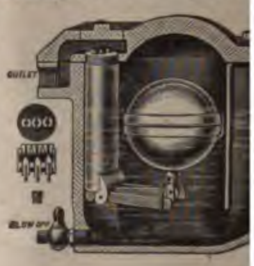

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The Purchaser of a Steam Separator

needs to discriminate with unusual care, for there are many makes and all bear the hackneyed label "The Best Made."

Each may be meritorious in one or more features, but sadly lacking in the complete make-up. Such separators soon prove detrimental to the user and he is forced to look for a better machine.

Now, if you, Mr. Reader, are contemplating the purchase of a separator, will you not carefully study the advantages offered by the extensive line of

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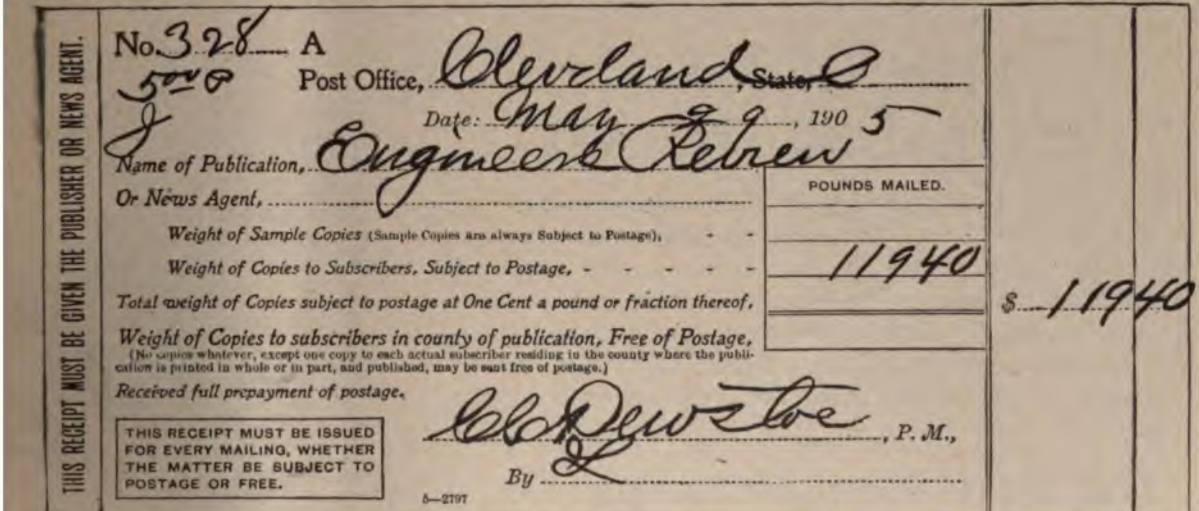

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Classified Index for Buyers.

For addresses of manufacturers refer to the Alphabetical Index on page 41, which gives the pages on which the advertisements appear.

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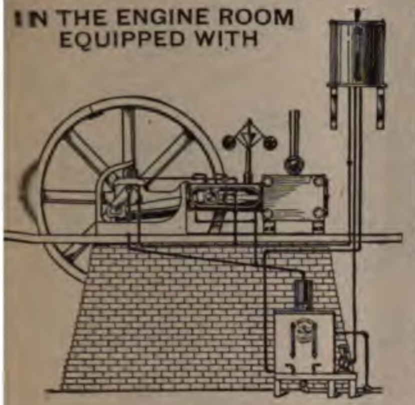
(Continued on page 44.)

IN THE ENGINE ROOM EQUIPPED WITH



The White Star Continuous Oiling System

There is no waste of oil; waste of time; waste of waste; oil-soaked floors; or bearings running hot.

But one handling of oil—from barrel to system. Booklet "J" tells you all about it.

Pittsburgh Gage and Supply Co.
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OIL FILTRATION EXPERTS.

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One Acme Oil Filter

cut down the oil bills of a concern, one hundred and twenty dollars in one year. The filter itself costs $30.00 and an ***Acme Filter*** will last for years.

We will send an Acme on

30 DAYS FREE TRIAL

AT OUR EXPENSE

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Walter L. Flower Filter Co.
1011 Chemical Bldg. *ST. LOUIS, MO.*

FAIR OFFERS We will send an **Indicator** or **Reducing Wheel,** or both, subject to examination at express office, to be returned at our expense if not found to be first class in every detail, or we will send one of our **Soot Sucker Tube Cleaners,** subject to trial and approval, to be returned if not satisfactory.

THE SOOT SUCKER draws the soot from the tubes without admitting steam into them.

Bachelder Indicator with Ideal Wheel attached

Complete, convenient and reliable; ready for various pressures without change of spring; guaranteed correct.

Spencer Damper Regulator. **Automatic Oil Cups.**
Grate Bars, all kinds.
Steam and Oil Separators. **Furnace Blowers.**

Send for our Catalogue.

JOHN S. BUSHNELL & CO.
123 Liberty Street, NEW YORK.

A Cleaner with Good Points Sticking Out All Over It.

This cleaner can now be furnished by the

Lagonda Mfg. Co.,
Springfield, O.

who have added to their own line the Water Tube Boiler Cleaner formerly made by the Gem Mfg. Co., Pittsburgh, Pa., having recently bought their Water Tube Boiler Cleaner interests.

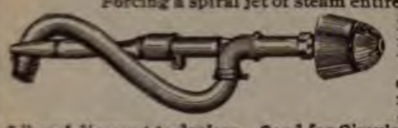
WRITE THE

LAGONDA MFG. CO.
SPRINGFIELD, O.

THE FAMOUS PHOENIX FLUE CLEANER

Has Six Adjustable, Self-Sharpening Interlocking Steel Blades with Bevel Edges. Doing perfect work even in spliced flues. Sent on trial and are delivered.

Hubbard & Co.
WASHINGTON, D. C.



Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.

Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO.

THE "LIGHTNING" TUBE GLEANER

Takes the Scale off QUICK inside and outside.

WARRANTED

To do the work in less time.
To cost least to keep it in repair.
To save ⅔ your water bill for cleaning.
To operate successfully by air, steam or water.

SEND FOR 7 REASONS WHY THE "LIGHTNING" DOES THE ABOVE.

Manufacturers of Boiler Head Cap and Nut Reseater and Cleaner, Perfect Expansion Flue Brush and X-Ray Oil Filter, etc.

MAURER, LABADIE & CO.

215 ST. JOE STREET, SOUTH BEND, IND.

HUSTLING STATE AGENTS WANTED

FOUR APPLIANCES
WITH BUT A SINGLE PURPOSE
ALL BUILT TO SAVE MONEY AND DO IT

FIRST THERE'S THE

Weinland Tube Cleaner

Gold Medal Winner at St. Louis, and winner wherever used. It's the cleaner the other fellows try to copy. We'll sell IT, or Power Driven Cleaners, or clean your boilers on contract.

TUBE CUTTER.

Cuts off tubes at any point—neatly, cleanly—without burr or bending. It costs little.

DAMPER REGULATOR

Controls damper in stack and stops waste.

RESEATING MACHINE.

Cleans header faces, nuts and caps quickly, perfectly.

The Lagonda Manufacturing Co.

SPRINGFIELD, OHIO.

"Boiler Cleaning Experts." "At it 20 Years."

NEW YORK, PITTSBURG. LONDON, ENG.

(Continued from page 42.)

Reducing Wheels
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.
Regulators, Damper
Bushnell & Co., John S.
Davis Regulator Co., G. M.
Lagonda Mfg. Co.
Robertson & Sons, Jas. L.
Regulators, Feedwater
Lagonda Mfg. Co.
Merrill, G. U.
Regulators, Pressure
Davis Regulator Co., G. M.
Foster Engineering Co.
Reseating Machines
Lagonda Mfg. Co.
Rope Dressing
Cling-Surface Co.
Rope, Transmission
Carpenter & Co., Geo. B.
Rope Transmission Wheels
Bates Machine Co.
Rope, Wire
Carpenter & Co., Geo. B.
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Goodyear Tire & Rubber Co.
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Rules, Steel
Starrett Co., L. S.
Saws, Hack
Starrett Co., L. S.
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Albany Steam Trap Co.
Austin Separator Co.
Bushnell & Co., John S.
Flower & Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
Lippincott Steam Specialty & Sup. Co.
Ohio Blower Co.
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Stewart Heater Co.
Shaft, Flexible
Gem Mfg. Co.
Squares
Starrett Co., L. S.
Staple Machines
Bates Machine Co.
Steam Specialties
Anderson Co., V. D.
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Lagonda Mfg. Co.
Lunkenheimer Co.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Reliance Gauge Column Co.
Williams Valve Co., D. T.
Wright Mfg. Co.
Stokers, Mechanical
Aultman & Taylor Mch. Co.
Model Stoker Co.
Strainers
Merrill, G. U.
Supplies, Engineers'
France Packing Co.
Lippincott Steam Spec. & Sup. Co.
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Supplies, Mill
Carpenter & Co., Geo. B.
Tape Measures
Starrett Co., L. S.
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Tools, Scraping
Mound Tool & Scraper Co.
Torches
Gem Mfg. Co.
Traps, Air
Wright Mfg. Co.
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Anderson Co., V. D.
Davis Regulator Co., G. M.
Flower & Co., Walter L.
Golden-Anderson Valve Specialty Co.
Lagonda Mfg. Co.
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Reliance Gauge Column Co.
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Valves, Back Pressure
Davis Regulator Co., G. M.
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Lagonda Mfg. Co.
Pittsburg Gage & Supply Co.
Valves, Gate
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.
Valves, Non-return
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Valves, Pump
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Whistles, Steam
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CENTURY
The Original White Packing.
FOR SALE BY LEADING SUPPLY HOUSES.

Our book, "Boiler Room Economy," in your hands, Mr. Engineer, will mean an end to your troubles with boiler scale.

SEND for this book TODAY.

It tells you all about BOILER SCALE—what CAUSES it and how REMOVED.

BOILER ROOM ECONOMY will lead you in the way of making your boilers ABSOLUTELY SAFE—will INCREASE their efficiency and reduce your fuel consumption.

Now you will ARGUE probably "My boilers are clean.'

But are you ABSOLUTELY SURE of it?

BOILER ROOM ECONOMY is an advertisement for the Dean Boiler Tube Cleaner.

Now the Dean Cleaner is the ONLY, SURE POSITIVE test that you have no scale.

Undoubtedly you are honest in YOUR belief that you have NO scale.

For every method of detection known, you have tried and still no scale.

But RUN a Dean cleaner through the tubes.

If you do this and no scale is dislodged then you can be POSITIVE you have NO SCALE, for if there was a pound, the Dean Cleaner would remove it.

It costs you nothing to make this test.

This is the Dean Boiler Tube Cleaner.

For Return Tubular Boilers.

For Water Tube Boilers.

It's the original cleaner of the hammer type.

There are over 5,000 in use all over this country, and England, Canada, Mexico, South America and South Africa have many in use.

We'll loan you a cleaner for trial in one boiler just to settle the question whether you have scale or not.

BOILER ROOM ECONOMY tells all about this loan offer and we'd be glad to send you a copy of this book NOW.

WRITE FOR IT WITHOUT DELAY.

WM. B. PIERCE CO.,
325 Washington St., Buffalo, N. Y.

30 DAYS' TRIAL
TO PROVE OUR CLAIMS

Ruggles Perfection Flue Cleaner

will quickly prove its worth in any plant.

It is the simplest cleaner on the market—being made of two parts.

No screws or rivets used in its construction. Sharpens itself. Absolutely cleans the flue. It is strong and reliable.

Send for one on trial.

RUGGLES & RUGGLES,
Batavia, Illinois.

"Noiseless Running."

Chicago Rawhide Gears and Pinions

"Original Rawhide."

Rawhide Hydraulic Packing

It is anti-frictional and the most durable on the market.

The Chicago Rawhide Mfg. Co.

SEND FOR CATALOGUE *71 Ohio Street, Chicago, Ill.*

Registered Trade Mark

If you want the Best Get

Gould's Steam and Water PACKING

In ordering give *exact* diameter of Stuffing Box and Piston Rod or Valve Stem.

See that our name and trade mark is on every package.

Gould Packing Co.
Albion Chipman, Treas.
East Cambridge, MASS.

Ring Packing.

almetto Twist Packing

A pound spool of Palmetto Twist in one hand and a monkey wrench in the other is all an engineer needs to pack every small valve in the plant in a very little longer time than it takes us to tell it, and they won't blow afterward either—no dirt—no dope—no grease.

Palmetto Twist is not only handy, but it will last three or four times as long as Asbestos Wick or cotton yarn.

Sample Spool FREE.

REENE TWEED & CO.
17 Murray Street, NEW YORK.

Style No. 92.
Sectional.—For Steam.

Took years to build up the reputation of

Crandall Packings

for durability, tightening qualities, convenience and lubricating value. The latter is simply remarkable because, **Crandall Packing** is thoroughly lubricated by a cold oil process entirely our own.

Don't take chances on any kind of packing that you might have trouble with, it won't pay, never has paid, never will. Of course, you have to get acquainted with the packing you use sometime, but you are pretty safe if you will turn to the packing with an established reputation for saving time and trouble.

When you buy packing, buy **Crandall**, you will know what you are getting.

Style No. 65.
Pump Plunger Rings — Hot and Cold Water.

CRANDALL PACKING CO.
Palmyra, N. Y.

NEW YORK
136 Liberty Street

CHICAGO
52 W. Washington Street

Lubron Packings

are specially treated with

(TRADE)
LUBRON.
(MARK)

They outwear and outlast all others and are self lubricating. If your packings give you trouble send us an order. If your packings work all right try ours once, they will work better. The only fault we find with our goods is that they wear too long.

THE LUBRON MFG. CO.
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Indicators Free

Tabor, Crosby or American Thompson

Did you get one ?

If you don't want an indicator you can choose any of the 500 articles numbered in our list. All of these are given free for coupons which come with every pound of soft and sheet and every inch of metallic packing.

France Packing Co., Inc.

STATE STREET, TACONY,

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Manufacturers of Metallic, Fibrous and Sheet Packing.

Our packings have been on the market for years and are used in the largest plants in the world.

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This coupon represents a ONE POUND PURCHASE

Five of these coupons are equivalent to one certificate and are redeemable according to our premium list at any of our stores.

FRANCE PACKING CO. INC.
HEADQUARTERS
Tacony, Philadelphia, Pa.

This coupon is redeemable and will help you to make a start.

For our free premium list fill out and mail us blank below.

Tear off Here

FRANCE PACKING CO.,
State St. Tacony, Philadelphia, Pa.,

Date...1905

Gentlemen:—Kindly send me premium list and full particulars regarding the indicators and other articles that you are giving to engineers.

My name is ....

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Give complete address

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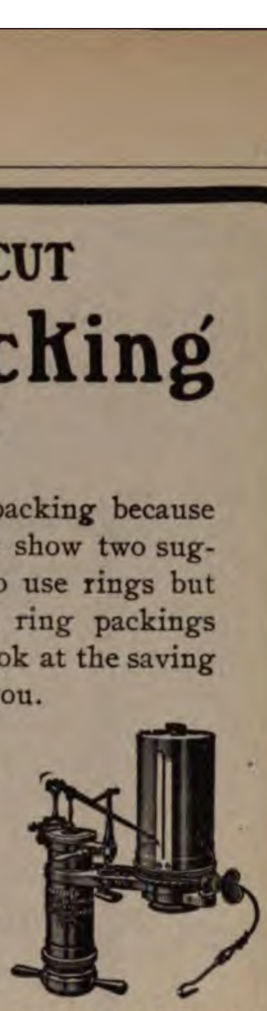
ING EUREKA INTO RINGS—STRAIGHT CUT.

IT IS EASY TO CUT
Eureka Packing
INTO RINGS

Some engineers use ring packing because they think it is handiest. We show two suggestions. Now, it is up to you who use rings but like Eureka Packing best. Most ring packings cost twice as much as Eureka. Look at the saving in cost and time which belongs to you.

A Robertson-Thompson Indicator



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Sent on terms to suit any engineer.

will help an engineer to a place that pays the best—more than any device we know of. Fact is, no engineer can ever be really successful from any standpoint unless he uses an indicator.

TTING EUREKA INTO RINGS-ANGLE CUT

Robertson-Thompson Indicators

are sold at a moderate price and on easy terms to those with references.

A Willis Planimeter

A WILLIS PLANIMETER

It is only a waste of an engineer's time to endeavor to figure by ordinates the M. E. P. from an indicator diagram. Nine times in ten the result will be incorrect.

A Willis Planimeter is easy to use and absolutely accurate, takes but little time and no figuring. Cost—moderate.

PERFECT FIT GUARANTEED

In stock at all times:
Victor Reducing Wheels,
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Shaking Grates,
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Jas. L. Robertson & Sons
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TELL US YOUR NEEDS.

Don't Mope!

YOU are not to be blamed for moping when you get through packing a stuffing-box if you *have* to use ordinary packing which produces so much friction that it will be ground to pieces in a week or so. But you can't kick if you *insist* on using ordinary packing after the evidence we have been producing for months and months, proving conclusively, by the experiences of your fellow engineers, that those who

USE P. P. P.

can forget there is such a thing as a stuffing-box for months, possibly years, at a stretch. If these proofs have escaped your notice send us the coupon and we will send you enough to convince you that a rod packed now with P.P.P. can be forgotten during the hot months, at least. Enjoy this summer as did the engineer in the following case:

"I packed my high pressure piston rod with P.P.P. on April 23, 1901. Although it was in almost continuous service night and day, the packing is still intact and giving good service.

ELMER E. WENTZ,
Chief Engineer,
Marquette, Mich., January 26, 1903.

Send the Coupon Today

The Quaker City Rubber Co. Philadelphia.

Gentlemen: Please send me your booklet proving that P. P. P. will save money

Name ____________

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City ________ *State* ________

Occupation ____________

Employed by ____________

ENG. REV.

and Smile!

HANCOCK INSPIRATOR CO.

The Hancock Valves.

Made in one Grade only

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Our Guarantee

We guarantee that each and every Globe, Angle, 60° and Cross Valve with our Monogram on it has been tested with 1000 lbs. water pressure and found tight before leaving our Works.

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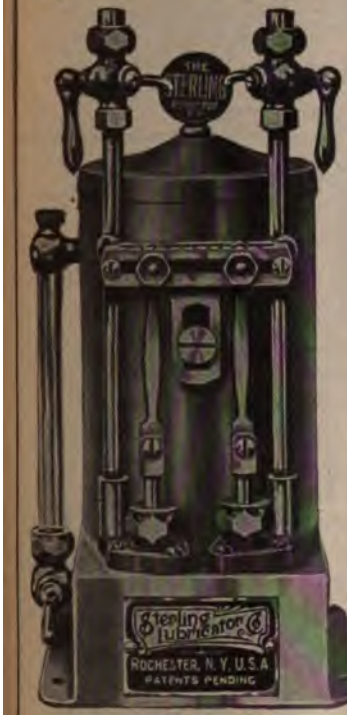
Write for our book of "Valves."

The Hancock Inspirator Co.

85-87-89 Liberty St.,
NEW YORK.

22-24-26 So. Canal St.,
CHICAGO.


THE STERLING
Sterling Lubricator Co.
ROCHESTER, N. Y. U.S.A.
PATENTS PENDING

IT'S UP TO YOU

Mr. Engineer, to practice economy in the engine room. One of the first principles is saving the lubricating oil. A

STERLING FORCE FEED LUBRICATOR

will save at least 30 per cent of your oil as compared with a Sight Feed Lubricator. The best material is used in the construction of these lubricators, and their efficiency is fully guaranteed. Lubrication is positive, does not require constant changes in feed or adjustment; will successfully lubricate all types of engines. Write for our booklet on lubricators.

Sterling Lubricator Co.

5 Frank St. ROCHESTER, N. Y.

THE BEST

Force Feed Lubricator

that money can buy.

FREE

For 30 days trial

IN MECHANICAL DETAIL

A New Improved Rochester Automatic Lubricator

Is absolutely perfect, built of nickeled brass and steel with cut gears, made to handle a single oil, or two kinds at the same time, with one, two, three or four feeds, and to deliver from a single drop to a small stream.

Sent anywhere in the United States with all necessary connections on

THIRTY DAYS TRIAL.

GREENE, TWEED & CO.

17 Murray Street, NEW YORK.

U.S. Automatic Injector

ON SEA OR LAND

Under all conditions--for marine, stationary, locomotive or threshing boilers--the U. S. Injector is by long odds THE BEST. It is the one perfect Injector. The U. S. government says so—200,000 engineers say so—and use is proof.

It is the stay-satisfactory injector. It always works, never balks--starts at lower steam pressure and works to higher than any other. Combines simplicity of construction and operation with extreme durability and dependability.

Buy of your dealer. Demand the genuine – U. S. stamped on each and accompanied by a Certificate of Range and Capacity.

Our **"ENGINEERS' RED BOOK"** is full of practical information, valuable to every engineer. We will send you a copy **FREE** if you will write for it. Better write today.

AMERICAN INJECTOR CO.,
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Engineers can depend upon the

Chicago Automatic Injectors

doing what we claim for them.

We have the most extensive testing plant in the United States and each injector is tested under actual conditions before leaving our factory.

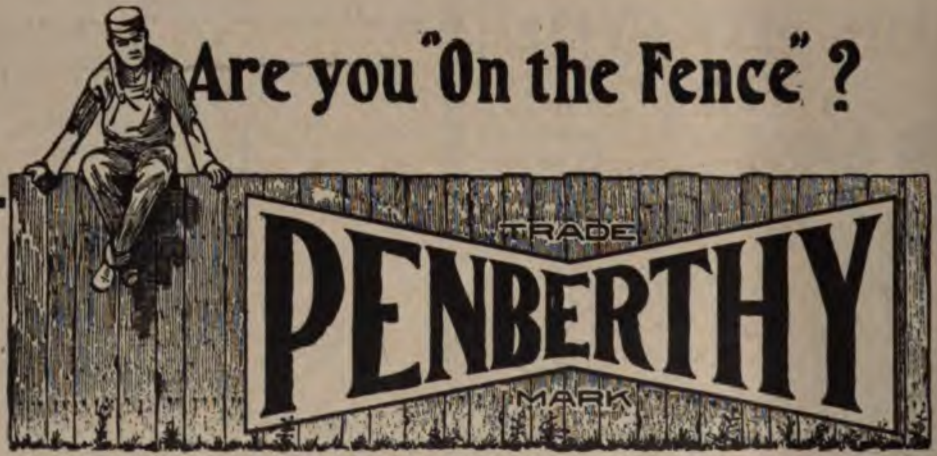
Place a Chicago Injector on your boiler and your injector troubles are ended.

The Chicago is for sale by all dealers.

Send for our 1905 catalogue showing our full line of Injectors, Lubricators, Grease Cups, etc.

THE CHICAGO INJECTOR CO.
WADSWORTH, OHIO.

Are you "On the Fence"?



Don't Buy an Experiment.

The Penberthy Automatic Injector

is the most thoroughly tested, high-grade, reliable and serviceable injector on the market. For twenty years the standard injector of America.

Penberthy Force Feed Oil Pump

has two ratchets which give it double length of life. Feeds oil to a drop, regardless of temperature.

Send for catalog of Engine Room Specialties and three months subscription to the Penberthy Bulletin free.

The PENBERTHY INJECTOR CO.,
Largest manufacturers of Injectors in the world.
345 Holden Avenue, Detroit, Michigan, U. S. A.
Manufactured in Canada by Penberthy Injector Co., Ltd., Windsor, Ont.

There is only ONE

ALBANY GREASE

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Cost of using Oils ▬▬▬▬▬▬▬▬▬▬
Cost of using ALBANY GREASE ▬▬▬▬▬

Use only the best lubricants on your Engines and Machinery. It will reduce friction, save wear and tear, reduces fuel bills and machine bills and results in Great Saving.

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

This Trade Mark on every package.

ADAM COOK'S SONS,
313 West St., NEW YORK CITY, U. S. A.

Some Facts about Detroit Lubricators

There are 800,000 of them in use.

More of them are sold than of all other makes combined.

They are used by fully nine-tenths of the prominent American Engine builders.

It requires merit to establish such a record.

Catalogue on application.

Detroit Lubricator Company,
DETROIT, MICH.

If it's a Lunkenheimer Whistle it will blow, because it is built on correct principles. Will give entire satisfaction. Always specify *Lunkenheimer* and order from your dealer. Write for catalog.

THE LUNKENHEIMER COMPANY, CINCINNATI, O., U. S. A.
Largest Manufacturers of Engineering Specialties in the World.
Branches: NEW YORK, 26 Cortlandt Street. LONDON, 35 Great Dover Street. PARIS, 24 Boulevard Voltaire.

VACUUM OILS

Are known and used in every corner of the globe where machinery runs. They are the standards of value throughout the whole world. They lubricate most on every kind of machinery; not the same oil for all machines, but the right oil for each class.

VACUUM OILS

Are made to fit every condition. That is why they are used wherever machinery is in operation. Admiral Dewey's fleet used them at the Battle of Manilla. The best users everywhere will have no others when they know their value.

VACUUM OILS

Are made at Rochester and Olean, N. Y., and distributed throughout the world from local branches. Abroad they are distributed from ***one hundred and twelve foreign warehouses,*** and at home they are sold in ***every city.*** The reason

VACUUM OILS

Are everywhere used is—they lubricate most. They reduce friction to the limit and save power. They are always uniform and can always be depended upon. They do their work better than all others, and cheaper, too, when the work done is figured. Other oils may sell for less by the gallon, but

VACUUM OILS

Cost the least by the day or month.

VACUUM OIL COMPANY, Rochester, N. Y.

CLASS
W
VALVE

FOSTER
CLASS W VALVE

maintains a regular uniform delivery pressure regardless of fluctuation in initial or boiler pressure. An absolutely dependable device. Built without weights, levers, or direct-acting springs.

For further information see Catalog.

FOSTER ENGINEERING CO.
Newark, N. J.

Starrett Speed Indicator No. 104

Price, Postpaid, $1.00

This Indicator may be run at highest speed required, without heating. The working parts are encased. Dial has two rows of figures, reading either right or left as shaft may run. Steel pointed spindle with rubber tips for both pointed and centered shafts. The 0 mark may be instantly set at the starting point.

Send for free Catalogue No. 171 of Fine Tools.

The L. S. Starrett Co., Athol Mass., U. S. A.

Have you got it?
IF NOT, GET IT.

That is, the POWELL HABIT, of quality and satisfactory prices--something tangible relating to Steam Brass Goods for the Engine and Boiler room, for mills, factories, railroad and engine builders.

This month we desire to call your attention to our

"CYCLONE"
BLOW-OFF VALVE

built on correct principle, has outside screw and yoke top and the "Powell" packing gland. Seat is removable and renewable. Disk is regrindable and reversible, having two faces to wear.

The disk is made of our incomparable wearing **Powelium Bronze, white as silver,** sure to give perfect satisfaction.

Each valve is tested to 250 lbs. hydraulic pressure and passes through a careful inspection before leaving our factory. All we ask is a trial to demonstrate its superiority over valves of this class. Manufactured by

The Wm. Powell Co.,
CINCINNATI, OHIO.

Mention Engineers' Review.

PRESSURE REGULATOR

It's Worth While

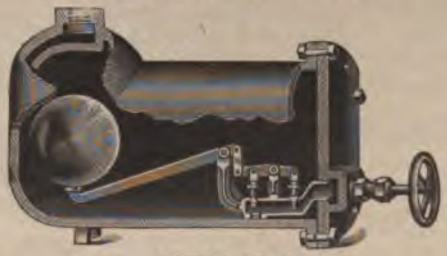
to investigate the merits of our specialties if you want to get the best results possible from the use of such appliances. We can refer you to any number of well known concerns using DAVIS VALVES who would substantiate all our claims, but better still we will send them to you **on trial,** and if they do not **make good** we will not expect you to keep them. Did you ever buy goods on a better basis?

All prominent jobbers sell DAVIS VALVES.
Complete catalog on application.

Pressure Regulators, Steam Traps,
Damper Regulators, Relief Valves,
Balanced Valves, Air Valves,
Back Pressure Valves

G. M. Davis Regulator Company

152 Milwaukee Ave., Chicago, Ill.
BOSTON NEW YORK SAN FRANCISCO
ESTABLISHED THIRTY YEARS.

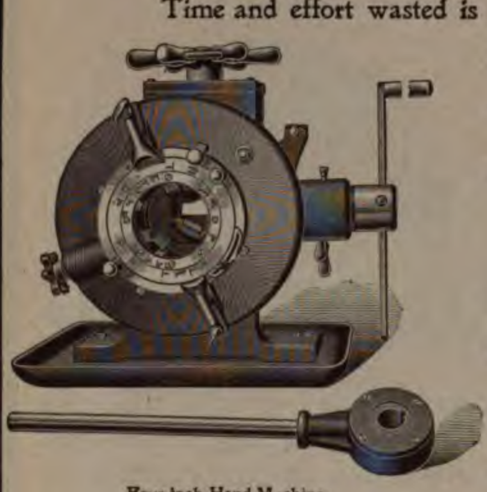


STEAM TRAP

"What we used to throw away is now our profit"

Time and effort wasted is profit thrown away.

Our Pipe Machines will save you time and profit.



Four Inch Hand Machine.

The OSTER MANUFACTURING CO.

99 E. Prospect St., Cleveland, O.

The "Williams Valve"

is setting a higher standard of workmanship and material than has ever been attained in the construction of a high grade valve.

The Engineer, who knows the good and bad points of all valves, will invariably use the 'WILLIAMS'. They are guaranteed.

Send for catalog, prices, etc.

The D. T. Williams Valve Co.

CINCINNATI, OHIO.

Toledo Adjustable

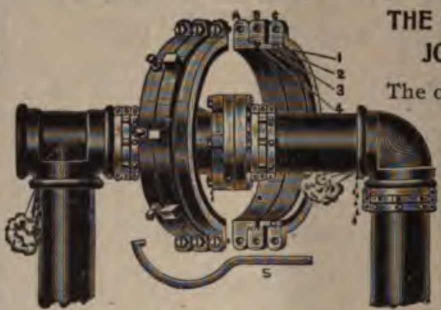
THREADING DEVICE

No. 3.

A strong, durable tool, yet light enough to permit carrying it from place to place on outside work. Threads pipe from 4½ to 8 in. inclusive. All machines guaranteed. Write for catalogue. Dept. E R.

Toledo Pipe Threading Machine Co., Toledo, O.

A PAIR OF LEAK STOPPERS

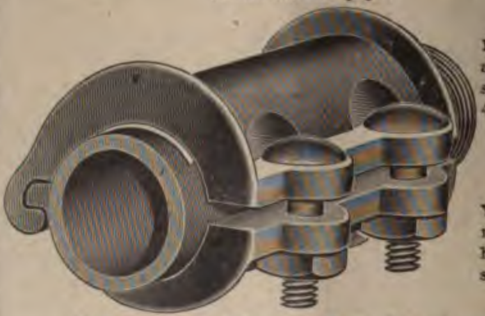


THE CLIMAX STEAM JOINT CLAMP

The only practical and efficient repair known for stopping leaks where pipes are screwed into fittings. Made of brass for all sizes from ½ in. to 24 in.

EMERGENCY PIPE CLAMP

Something you have been looking for to repair splits and leaks on the pipe.



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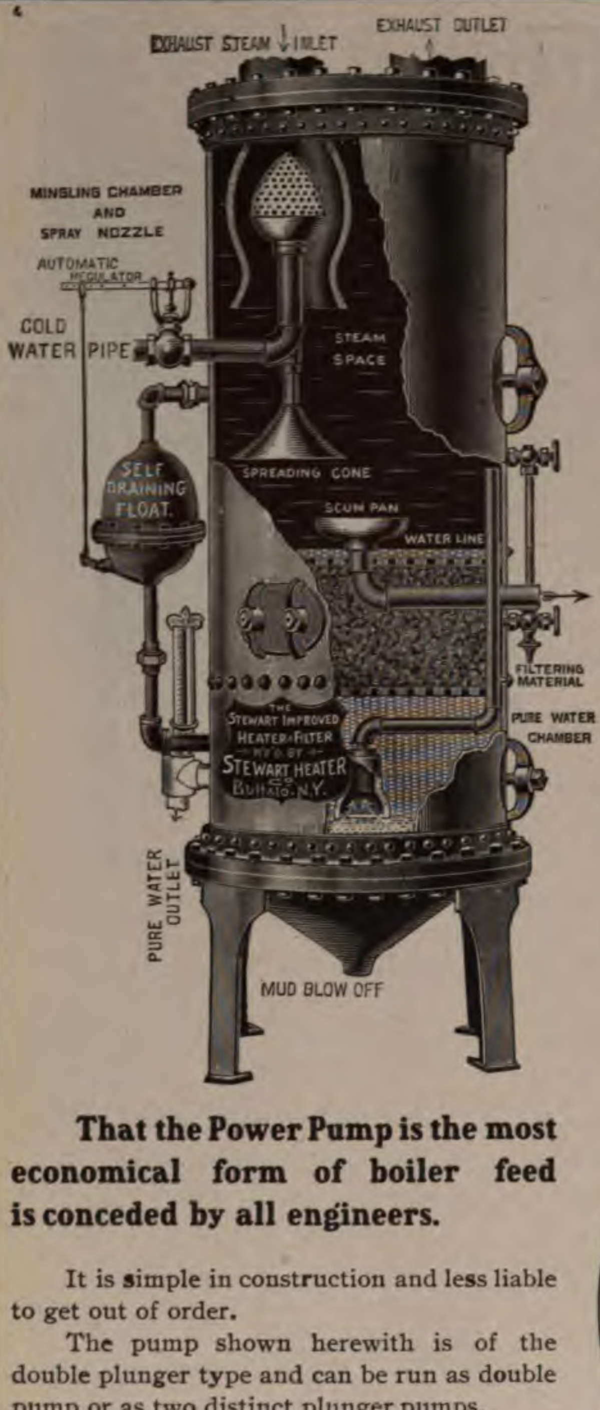

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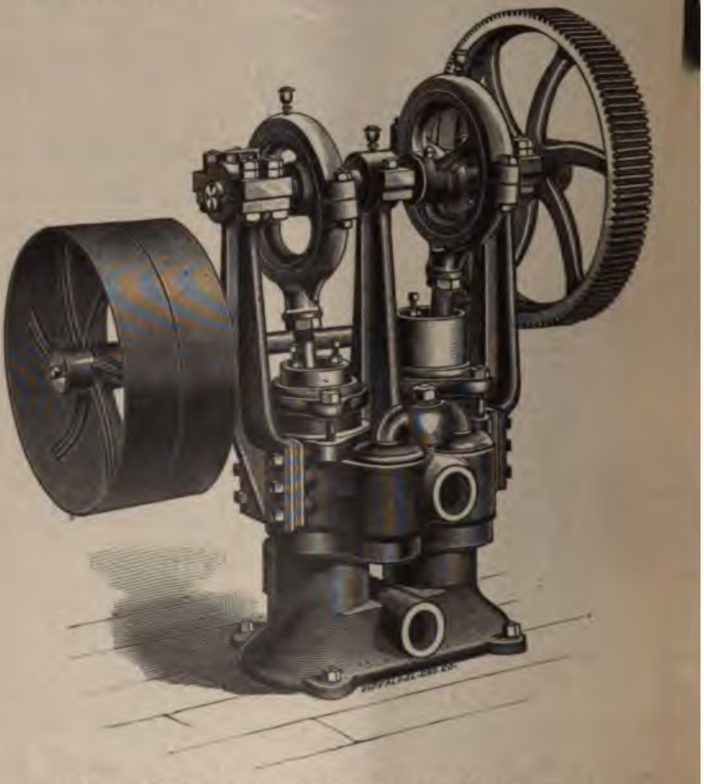

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4½	2¾	4	200	40
5¼	3½	5	350	70
6	4	6	500	100
7	4	8	600	125
7	4½	8	750	160
8	4½	10	900	175
8	5	10	1000	215
10	5	10	1000	215
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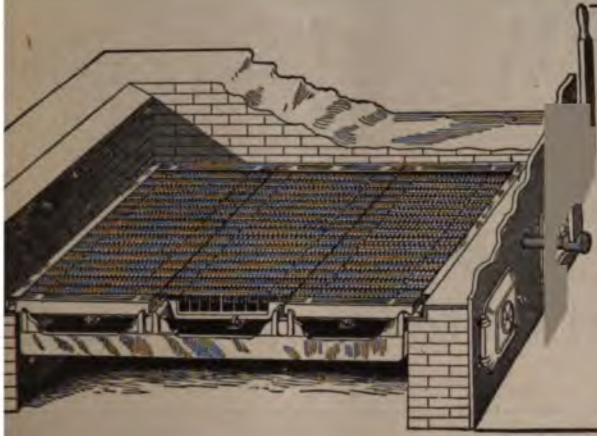

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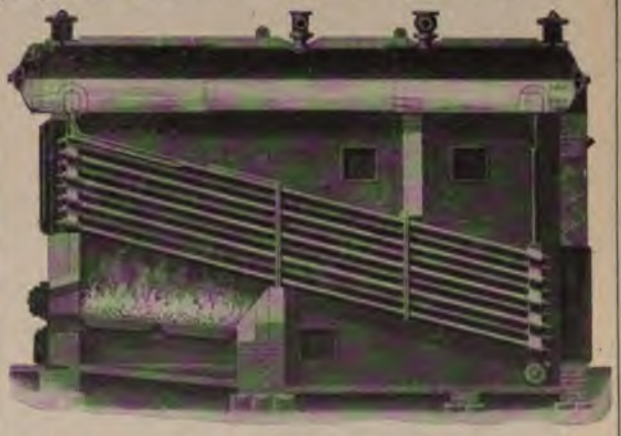

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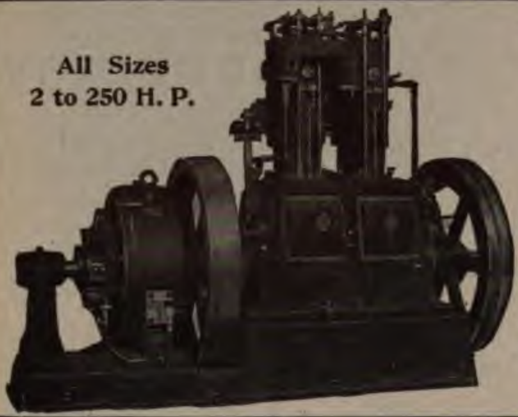

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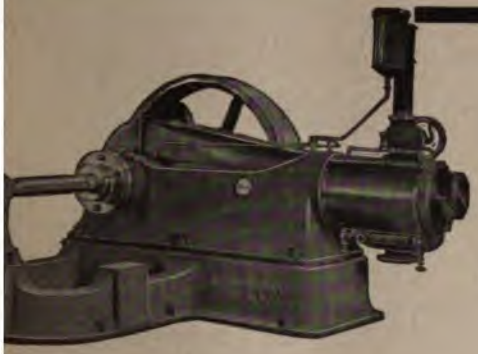

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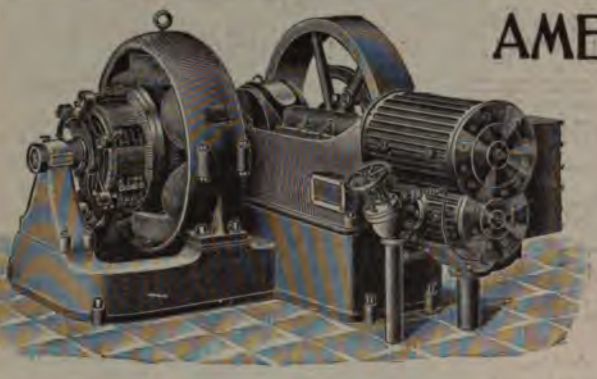

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Let us Prove it to you by Furnishing a Combination Heater for your Plant this Spring —Subject to Trial.

The COOKSON has many advantages over all others:

Maintains higher temperature of feed water without back pressure on engines. Constant temperature 204-212° F.

Will heat more water with less steam than any other.

The steam only that is to be condensed comes in contact with the water.

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Has more lime catching surface and filtering capacity than any other.

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CLEVELAND, JULY, 1905.

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Messrs. Adam Cook's Sons,
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Gentlemen:

Albany Grease Cup and sample of Albany Grease received. I will say I put the cup on the wrist pin of an engine that had always given a great deal of trouble, and from the very first use of the grease, the pin ran cool, and has done so ever since, although it is badly overloaded. My customer got a supply of the "Albany" of a firm in Chicago, and has used it on all his machinery where possible ever since, and I am very certain he will make a permanent customer.

One thing he told me was, he had always been prejudiced against your grease on account of its costing him considerably more per pound than other kinds, but he has found out that it took so much less that it really was the cheapest—and then his bearings ran cool.

I have another customer who would be a convert if you care to send a cup, and he says if he keeps the cup he will pay for it, which I will remit to you. It would be about the same kind of cup, only this would be a 3-8 inch shank, and the depth of hole of bearing is 15-16 inches. You would not need to go to the expense of sending samples of the grease as I can get plenty here. Should you choose to send the cup please say what they are worth at retail.

Yours respectfully,

L. P. HARVEY.

ADAM COOK'S SONS,

313 West Street,
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A SCIENTIFIC TEST

The late Prof. Thurston says in his treatise which has been accepted as an authority on Friction—

"Friction may be said to be in proportion to the heat generated."

Tinius Olsen, the noted M. E. and builder of Testing Machinery, upon testing samples of the best known oils and greases on the market, reports—

> *"The bearing tested, running under the same conditions and the same length of time, grew hotter with each other lubricant than with Keystone Grease."*

Is it necessary to draw a conclusion?

We will send a sample of Keystone Grease and a brass grease cup to any engineer giving business address, and advising us of the H. P. of his engine and size of tap in which cup will be used.

GUARANTEE
1 lb. of Keystone Grease=4 to 6 gals. of oil.
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Keystone Grease is made and sold only by us: any dealer offering Keystone Grease is offering a substitute and will be prosecuted for the imposition.

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ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

VOL. 16. CLEVELAND, JULY, 1905. No. 5

DETROIT EDISON TURBO-GENERATOR STATION.

The Detroit Edison Co. have recently constructed at Delray, a suburb of Detroit, a new generating station, which is equipped with alternating current turbines. This company is to supply power at wholesale to the electrical companies of Detroit, for which purpose 12,000 kilowatts are to be developed from four units, each of which is of 3,000 kilowatts, capacity.

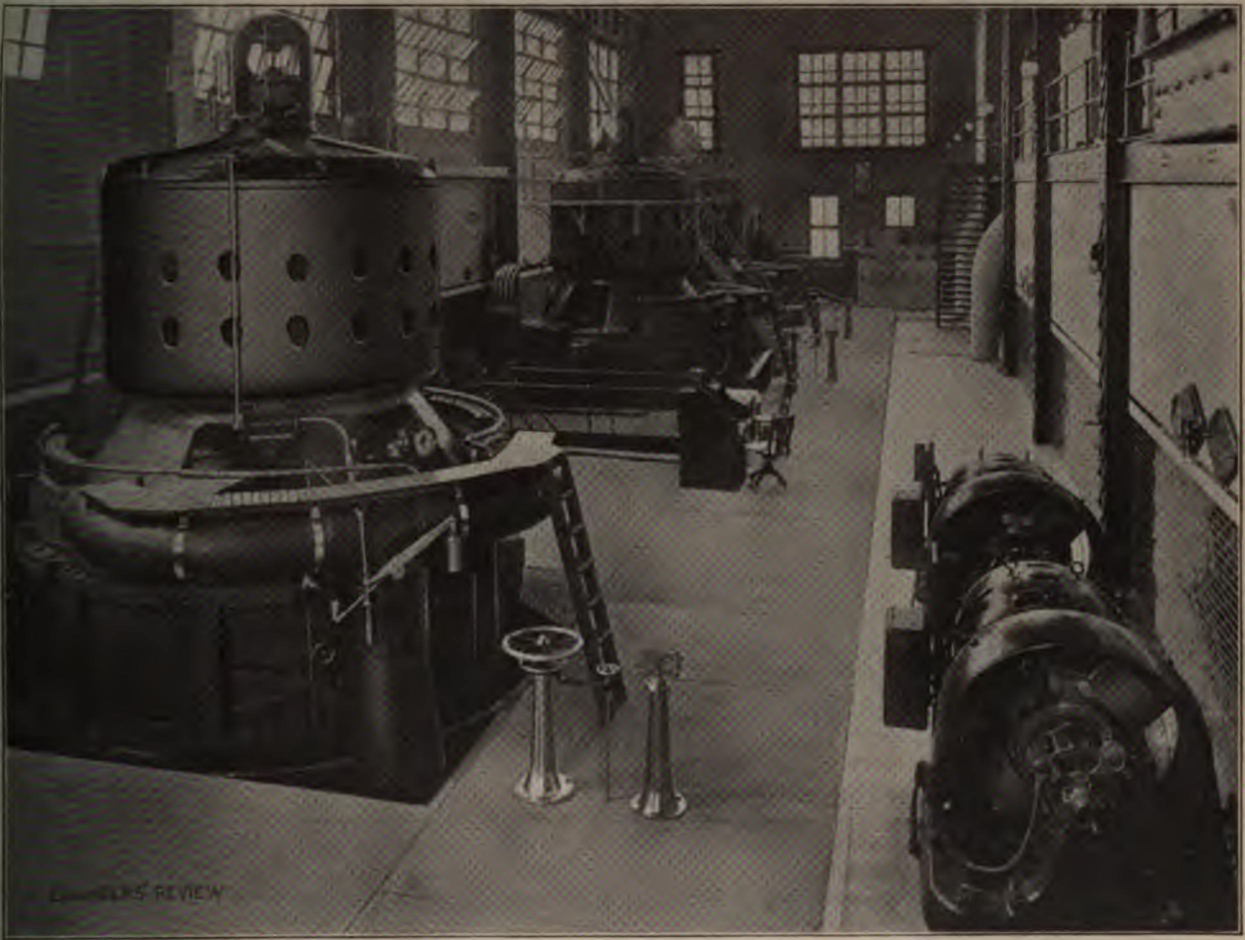

FIG. 1. CURTIS TURBINES OF THE DETROIT EDISON TURBO-GENERATOR STATION.

As will be seen in the illustration, Fig. 1, the prime movers are Curtis turbines, which are arranged to run either condensing or noncondensing.

This plant has sufficient boiler capacity at all events, as enough boilers have been provided to develop the full 12,000 kilowatts with the turbines running noncondensing. With two or three minor exceptions, the auxiliaries are driven by alternating current motors.

The boiler room is divided into two compartments, each containing 12,500 horsepower of Stirling boilers which are equipped with superheaters. The boilers are arranged in batteries of six, on each side of the firing alley, which is the center of each compartment. Thus it will be seen that each row of six boilers has a capacity of 3,000 horsepower. The boilers are connected to four 12-inch headers, each header being connected to one of the turbines, making a complete unit of each row of boilers and its corresponding turbine. At present eight boilers are in position. There are four main headers which are cross connected by 8-inch headers.

In the piping long sweeping bends are provided to allow for expansion and contraction, and steel flanges and special fittings are used on all the piping, which is protected by nonconducting covering 6 inches thick and over. The boilers are equipped with Roney stokers, manufactured by the Westinghouse Machine

Co., two of which are provided for each boiler, having an effective grate area of 63 square feet and are operated by Westinghouse standard engines of 10 horsepower capacity. Two engines are provided for each row of boilers and are so connected that either may be used to drive 12 stokers. The coal is fed from the bins overhead into the stokers through chutes. A cross section of the boiler room is shown in Fig. 2. The arrangements for handling coal and ashes are complete, the company having a track of their own connecting with the railroad. The coal is conveyed in hopper cars from the siding and up an incline to the base of the coal tower. In the coal tower it is hoisted, cracked, screened, and delivered by a "Hunt" automatic railway system to the different coal pockets, of which there are six, having a total capacity of 4,000 tons.

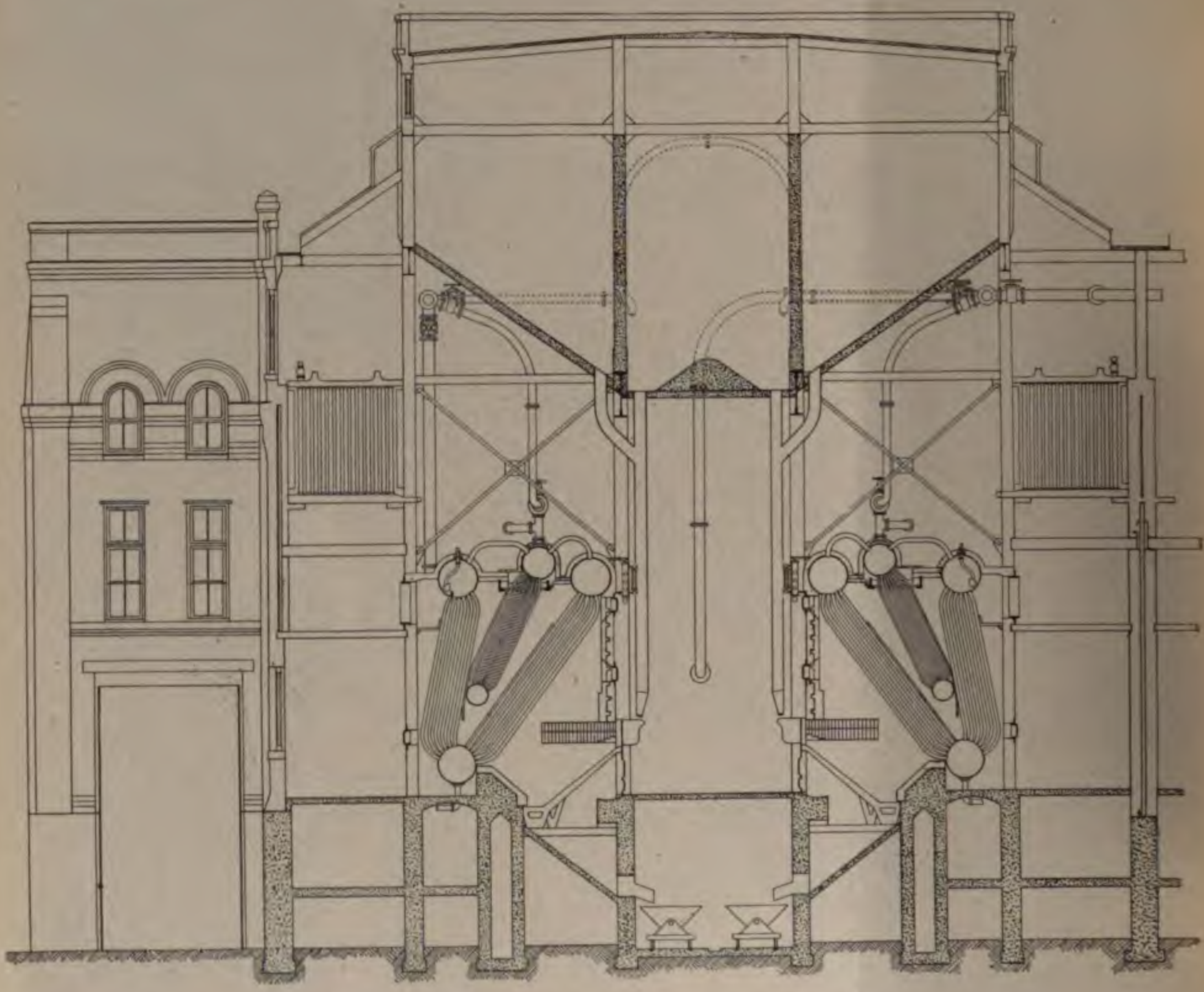

FIG. 2. CROSS SECTIONAL VIEW OF THE BOILER ROOM.

The feedwater for the plant is obtained from a 40-foot canal which has been dredged out for this purpose from the Detroit river to the pumping station, where it is raised through screens and strainers by Worthington turbine type of pumps. The pump room is shown in Fig. 3. The water is forced up through a system of underground mains to the boiler room, and General Electric induction motors, operating at 220 volts, 60 cycles, at a speed of 900 revolutions per minute drive the pumps. The water is taken from the mains through four 5,000-horsepower Cochrane feedwater heaters by Worthington feed pumps having Corliss valves. The temperature of the feedwater is raised somewhat in the heater by the exhaust steam from the steam auxiliaries, after which it passes through Green economizers which are arranged in four banks, each bank containing 104 sections of 12 pipes each which are subject to a working pressure of 150 pounds per square inch. The boilers are also equipped with 500 horsepower Penberthy injectors, which are operated with saturated steam, for the makers do not guarantee their operation with superheated steam.

The superheater as arranged in the Stirling boiler is shown in Fig. 4. It will be seen that the upper superheater drum is divided into three compartments, Fig. 5, each of which contains a manhole as shown at *A*, *B* and *C*. The lower drum is divided into two compartments by means of a removable diaphragm. Saturated steam enters the compartment *D* of the upper drum and then passes through the tubes four times as shown by the arrows until it finally reaches the compartment *E*, whence it passes into the steam main. The superheater may be flooded and used to generate saturated steam if desired. In order to do this the upper steam drum and the lower superheater drum *F* are connected by suitable piping and valves as shown by the dotted lines *R*, Fig. 4. When saturated steam is being generated all the compartments in the upper superheater drum are thrown into communication by means of the bypass valves *G* and *H*, Fig. 5. The steam generated in these boilers is carried at a pressure of 200 pounds and is superheated at 200 degrees F. although the Detroit Edison company have been able to get 300 degrees of superheat from them without the least difficulty.

The stacks of this plant are three in number, and extend 135 feet above the boiler room floor. The largest stack has an internal diameter of 16 feet and is placed in the center and is to be connected to 12 boilers while the two smaller stacks, 11 feet in diameter, serve 6 boilers each. The stacks are constructed of steel and are brick lined to the top. Forced draft is used, four fans being employed, two for the larger stack and one for each of the smaller. The fans were built by the Niagara Radiator Co., and are driven by a Chandler & Taylor, 14 x 16-inch horizontal engine.

A cross section view of the general appearance and arrangement of the turbine room is shown in Fig. 6. The turbo-generators and exciters occupy the south side of the room, while the operating and controlling system is placed on the north side. Fig. 7 is a plan view of the boiler and turbine rooms and pump house. The 24 boilers are shown at the right, and the turbines at the left of the main building. On the extreme left is shown the pump house. The coal tower is shown at the upper right hand corner of the plan.

The Curtis turbines which are of 3,000 kilowatts each are of the four-stage type revolving at a speed of 600 revolutions a minute. There are 24 controlling valves which are actuated by electro-magnets. Water is used for the step bearing, and is taken from the mains by two Dean pumps which are set in relay. The water is forced into a D. Wood & Co.'s design accumulator which is made to stand 900 pounds pressure per square inch. Only 650 pounds pressure is required to balance the weight of the revolving parts of the turbine. The water escapes through a relief valve, set to operate at this pressure, into the vacuum chamber of the turbine from which it is returned to the hot well, and then carried to the storage tanks over the boilers in the boiler house.

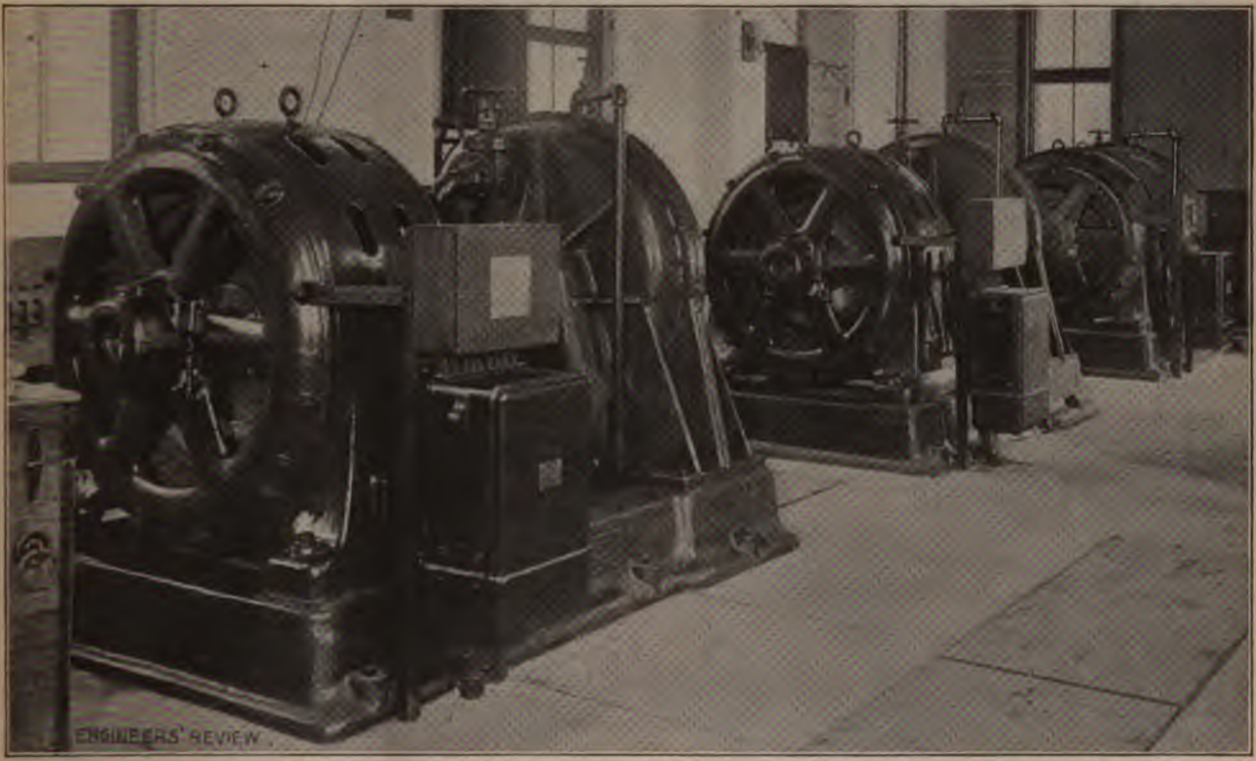

FIG. 8. PUMP ROOM SHOWING WORTHINGTON TURBINE PUMPS.

The condensers are of the Wheeler design and have a cooling surface, composed of 1-inch tubes, 12 feet long, equal to 12,000 square feet. The condensers are located below the turbine floor and are therefore not shown in the illustrations. The water of condensation is returned to the hot well and then to the boilers. The circulating water is supplied by a 20-inch Wheeler centrifugal pump which is driven by a General Electric induction motor, of 75 horsepower. The overflow empties into a canal running from under the condenser to the river. The vacuum is attained by means of an Edwards three-cylinder patent air pump manufactured by the Wheeler Condenser & Engineering Co., and is driven by a 60-horsepower induction motor.

Each generator is strictly independent and the unit system is strictliy adhered to in the electrical end of the plant, although tie switches are provided and any machine may be thrown in parallel if it is desired. A three-phase, 60-cycle current is generated at 4,600 volts and is transmitted directly through the headers to the various points of distribution. Where it is desired to use direct current, motor generators are installed at the receiving end, to transform the current from alternating to direct current.

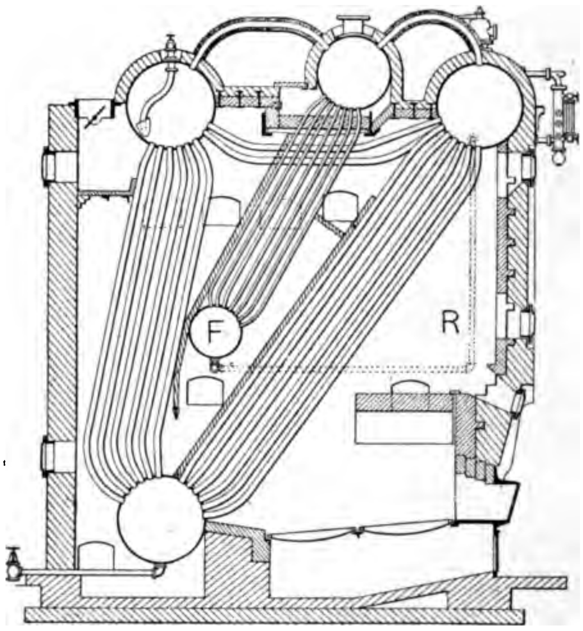

FIG. 4. STIRLING BOILER EQUIPPED WITH A SUPERHEATER.

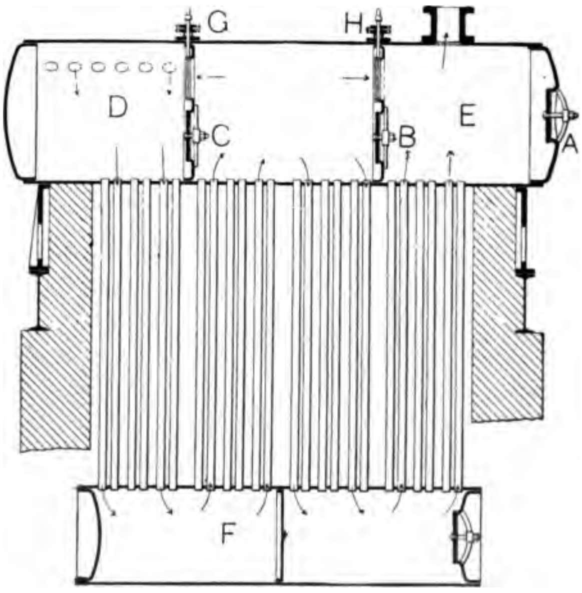

FIG. 5. SHOWING COMPARTMENTS IN SUPERHEATER DRUM.

The greater part of the station output will be by the direct current system and taken by the Edison Illuminating Co., of Detroit. A three-phase current at 2,200 volts and 4,400 volts is furnished to the Peninsular Electric Light Co., while other companies are furnished with lesser amounts. But a small portion of the power will be used by the different auxiliaries which are operated by motors of the three-phase type and are operated at 220 volts, 60 cycles.

The exciter system consists of two 50-kilowatt motor-generator sets, an auxiliary steam unit, of 75 horsepower capacity and a storage battery. The motor generator sets are installed on the turbine floor and consist of a 75-horsepower induction motor and a 50-kilowatt direct-current generator, which may be operated at any voltage between 125 and 220 volts. A steam exciter is installed in the basement and is to be used as an emergency unit.

The switchboard consisting of 26 panels of white Italian marble, is located on the second gallery and is divided as follows: two exciter panels, one synchronous panel, four generator panels and 19 feeder panels. The high tension bus-bars are immediately below the switches and are placed in a fire proof vault where they are again enclosed in brick compartments. A 35-ton crane reaches across the turbine room and conforms with the general design of cranes made by the Northern Engineering Works and is operated by alternating current, General Electric induction motors. In the condenser room are located two 15-ton cranes made by the same company, while in the pumping room is a 1-ton crane used in the operating gallery.

An important feature in this plant, which is noticeable and one which is of the utmost importance in large installations, is the precautions against breakdown. In this plant practically all apparatus is set in relay, and it will indeed be a serious accident which will interrupt service for any extended period of time.

ENGINE ROOM CHATS NO. 20.

BY A. GOVERNOR.

"Ter-morrer have throuble ter lind,
  An indless, indless shtore;
But Oi have as much as me heart can hold—
  So why should Oi borrer more?
Ther toime———"

"Oh, shut up! What's the use of singing about things that are always with you? Don't you know that a man never has to go half way in order to meet trouble? Let up on the thing and give us something else to think about. A song like that is enough to make anyone think that the world is full of misery."

At these words Dan Googan straightened up after finishing the task of deftly spreading a thin layer of coal over the fires and said, "Misrey loikes company, be dad, but just ther same Oi'd rather have ther reumatiz in one leg thin in ther booth, so Oi would."

"Talking about trouble makes me think of the trouble I've been having with the last barrel of oil I got, and what the matter is I don't know. The salesman says it is the same as the last lot, but I know a blamed sight better," and Dave Hill brought his foot down on the fire room floor in a very decided manner.

"Them fellows have changed in a good many ways in the last 20 years, I have noticed," said Pete Haynes, "I can remember when they came into an engine room as if they were the owner and a fellow almost felt as he were negligent in hospitality if he didn't get up and give the drummer his chair, in case he happened to be setting down. If he wasn't setting down the drummer got the chair any how.

"I remember when one of the fly kind came in one morning when I was a little mite busy and began to tell me that I didn't know what kind of oil I wanted to use on my engines. I had never traded with him and didn't for some time after. If there is one thing that will make me sore, it is to have a man come to me and run down another man's goods. It shows at once that he don't think the engineer has sense enough to tell the difference between one kind of stuff and another.

"That's the way this fellow did and I stood it about as long as I could and then lit on him about as heavy as any fellow ever got lit on and come out of it in a frame of mind that allowed of his thinking he would ever get back any of what little self-respect he might have had in the first place."

"What did yer say?" asked Steve Brown in his drawling tone of voice.

"I says among other things, 'Young man it don't pay to lie, for your lies must all be kept on file mentally, and in the course of time some of them are pretty sure to throw you, and a liar wants a better memory than I think you've got. You come here and tell me the wonderful qualities of your goods, but I don't swallow all you say. I take it that you are a new man on the road or you would know better than to come into a man's engine room and try to tell him about things he knew before you were born.'

"I told him that I didn't have any doubt but that his goods had good points, but that there were others. I wound up by giving him a little fatherly advice

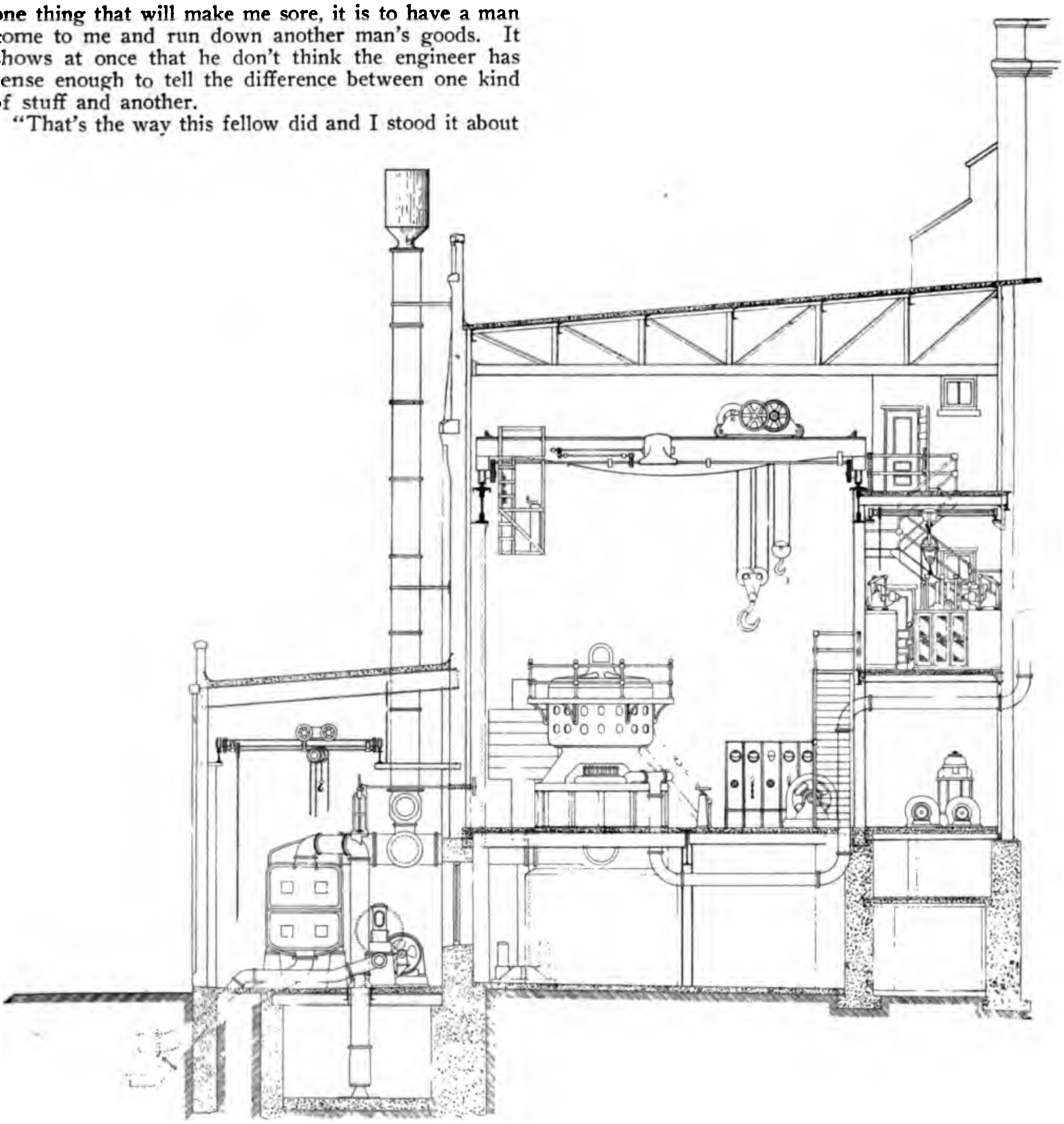

FIG. 6. CROSS SECTIONAL VIEW OF THE TURBINE ROOM.

tel
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[illegible]

up cylinders than a tom cat ever did with kittens. I tell yer when you fellers get to talkin about ilin engins, you got me right where I am to home. I have had more doggon trouble with engin cylinders than I ever did with Christmas presents. I know one thing that the size of the cylinder is what enters into the question and holds the A No. 1 place. Then agin the condition of the surface and how it is arranged, steam pressure and whether steam is soaking wet or not, and the speed of the engin and speed or velocity of the piston has a durn good deal to do about it."

"Vot vos velocity?" asked Fritz Switsenberger.

"Sure the manin is dead aisy. It's what a fellow lets go of a bumble bee wid."

"Well," said Sam, "There are lots of things about cylinder lubrication that's worth knowing as Steve has said. The extent of the surface is one of the first propositions that enter into the question, and the steam pressure, condition of the steam and the speed of the engine has a whole lot more to do with it. I guess we have all found out before this time that these points govern the quantity and quality of oil that is necessary to use. In a good many of our high speed automatic engines, piston and balance valves are used because they reduce the friction to almost nothing and so lessen the work on the governor which, to my way of thinking, isn't any too sensitive. A good many engineers think that piston valves are used because they cannot be lubricated easily if made otherwise, and we all know that a governor wants to work as easy as the law will allow."

"You bet yer life," interrupted Steve Brown, "I have seen fellers put the packin in a stuffinbox and screw it up so blamed hard agin the valve stem, as to make the engine race worse nor a two year old colt."

"By jinks," exclaimed Dave Hill, "neglecting the governor ain't the only thing that raises trouble around an engine. I have seen a whole lot of high speed engines that use the solid piston, grooved out in the regulation way to take snap rings, which were made in one piece. You all know that the wear will naturally come on the bottom of the piston and cylinder and when it does take place it just puts the piston out of line with the cylinder.

"When it comes to the crank end, the piston is brought nearly in line with the cylinder because the crosshead between the guides and the piston-rod in the stuffingbox brings it that way, but when the crosshead is at the head end of the stroke the piston will be down on the head end of the cylinder and right here is where the trouble begins. When steam is admitted to the cyinder at that end of the stroke it gives the piston a rap and forces it to the top side of the cylinder, and the engineer will tell you his engine has got a thump, and he can't tell where it is.

"When the piston is forced up to the top of the cylinder it relieves the strain on the crosshead and piston-rod, of course, and then the crosshead drops down on the lower guides and makes a knock at the other end of the stroke, so you get two knocks with each revolution of the engine and the engineer is more puzzled than ever, but the blame is really that of the piston."

"Well, that's pretty good," said Steve in a tone of approval, "but I can give you a few more pinters on sich things. You know there's a lot of high speed engins of one kind nor another that's got a fair to middlin heavy valve which rides in the steam chest on edge. Well after a time it wears a groove in the steam chest and that's where water settles and being on the bottom, water will reach the place before oil will. Didn't you ever notice that? Well I have, and I found out after more or less experimentin' that I just had to get an ile that would mix up more or less with water, and kinder git acquainted like, afore I could git the valve iled to suit."

"Talk about ile and engins" said Dan as he stuffed the bowl of his short stemmed pipe full of tobacco, "Bedad Oi worked with an ingineer wanst that took th' cake whin it came to ilin ingins. If I remimber roight, they were Russell ingins such as they built some years ago and had a little valve in the cylinder bleeders which was used ter regulate and cushion th' piston and th' valves at each ind of th' stroke.

"Well me ingineer got down on the ile man and he put up wan of the neatest thricks on him that was iver me luck to notice. He made up his moind that he didn't want the ile and so bedad, he jist worked at thim little valves and made the injin knock like the divil. Thin he got the old man down and gave him a song and dance about the ile being no good and swore up and down 'twas the same that made the ingin pound. Roight thin and there the old man swore he would buy no more of the same ile, and wan day after the new ile came the boss came out to find out how things was goin. Well that ingin was runnin as nice and aisy and as peaceful like as a little baby slapes when he is so full he can't ate no more, and every blissed thing the ingineer done was to jist adjust thim valves and the ile did the rest."

"That's nothing, there's other engines beside high speed engines that have troubles. I ———" began Dave Hill.

"You will have to cut it out about your Corliss engines for today," said Bill Ross as he looked at his watch, "it's time for us fellows to get a move on and get started up or someone else will have a chance to do the oiling," and each one hastily glanced at his watch, grabbed a dinner-box and left for his own engine room.

"Bedad Oi hope that thim fellows don't intind ter groan over ther misfortines of others in ilin ingins and ther loike, because it wrinkles ther moind, and furrers ther brow, it withers ther heart and above all things it bores ther whole gang ave humanity, so it do."

Largest Centrifugal Pump in the World.

The largest high-head centrifugal pump ever made in one unit was built by the Byron Jackson Machine Works of San Francisco for a large mining company in Oregon. It represents one of the biggest pieces of modern pumping machinery ever turned out.

The pump is of the series five-step type and built to withstand a pressure of 250 pounds per square inch, or a total lift of 580 feet, and is to supply 9,000 gallons of water per minute. The pump is driven by four 400 horsepower turbine water wheels, direct connected.

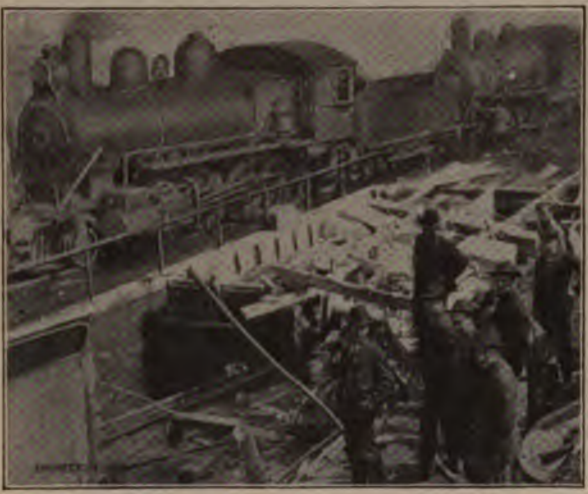
The clogging up of the oil feed which lubricates the crankpin on a 700 horsepower steam engine caused the brasses to stick to the crankpin, with the result that the crosshead was broken into bits and the connecting-rod was bent into a semi-circle.

LOCOMOTIVE EXPLODES.

BY C. C. JOHNSTON.

A locomotive explosion that has attracted wide attention from railroad people by reason of its mysterious cause occurred in the Hocking Valley yards at Columbus, O., May 22d.

Freight engine No. 41, which had been undergoing extensive repairs in the local shops of the company, was being tested preparatory to going back into service. Shortly after the noon hour it was run out of the round house to a point in the yard several hundred feet distant, in charge of a crew of hostlers, where the work was continued. One of the men was on top of the boiler for the purpose of screwing down the safety valve when the maximum of 150 pounds pressure, the standard for this class of engines, was reached. Another man was inside the cab watching the steam gage, so as to give notice when the exact figure was recorded.



REMAINS OF THE EXPLODED LOCOMOTIVE IS SHOWN IN FOREGROUND.

The engine had been out of the round house less than half an hour when it exploded, instantly killing the five men employed about it at the time and also a trimmer engaged in trimming a yard arc light, some 25 feet away. The bodies of the men were blown to a distance of 100 to 300 feet. All were picked up in a more or less mangled condition. One of the arms of the trimmer was found on the top of a caboose, 50 feet from where the rest of his body lodged.

When the cloud of steam had lifted nothing was to be seen of the engine proper but the trucks. The front section of the boiler, a mass of metal weighing 6,000 pounds, had been shot forward 100 feet. The firebox, comprising a weight of 3,000 pounds, was discovered in an opposite direction, 200 feet from the point of exploson. The dome of the engine landed against a shed of a neighboring manufacturing plant, 600 feet away. Smaller parts were strewn in all directions. The drive-wheels were wrenched from the axles and some of the ballast blown from beneath the track. The tender was practically uninjured. Several locomotives standing in close proximity were painted white from the magnesia lagging of the exploded boiler and two of them suffered slight damage.

The railroad officials state that they have no satisfactory theory as to the cause of the explosion. The engine had seen 14 years' service, but had just been overhauled and placed in first-class condition, a new firebox being among the improvements. Just before leaving the roundhouse steam blew off at 60 pounds pressure, which would dispose of the supposition that the safety valve might have been screwed down. The man in charge of the engine had been a trusted employe of the company for twenty years. The clean, unmelted appearance of the parts after the accident showed that it could not have been caused by low water. The whitened surroundings led to a popular theory at first that a careless employe had overdosed the boiler with soda ash, used in softening the water. The railroad authorites claim that even were it possible for such an explosion to have had a chemical origin, this engine was in service on the southern division where no softening process of the water is employed. Soda ash is used in boilers of engines running north, but in very small quantities.

A peculiar feature of the explosion is that instead of a hole being torn in the side of the boiler, as is usually the case, the engine was completely demolished, as shown in the illustration, the parts flying in all directions. The accident, it is claimed, had more the nature of having been caused by some foreign substance of a highly explosive nature which found its way into the fire-box with the fuel. This possibility is seriously considered by the railroad company. The engine was the Mogul type, refitted several years ago with the Belpere boiler, and weighed, exclusive of the tender, 110,000 pounds. The property loss is placed at between $6,000 and $7,000.

CONVENTION OF THE OHIO SOCIETY, N. A. S. E.

The eighth Ohio State convention of the National Association of Stationary Engineers held at Cleveland, Ohio, June 15, 16 and 17, was as interesting and successful as usual. The convention was held in Gray's armory, which building also housed the exhibits. Headquarters were established at the Euclid hotel, which was convenient to the armory. A reception was held Wednesday evening in the parlors of the hotel to the delegates and friends.

Thursday morning the convention was called to order at 10.35, by J. L. Sanderson, chairman of the local convention committee. City Solicitor Newton D. Baker, representing Mayor Tom L. Johnson, delivered the address of welcome. In the absence of Royal D. Tomlinson, National Vice President, response was made by Chas. H. Garlick, National Past President. Remarks by National Past President H. E. Stone, State Deputy Chas. L. Strong, National President of the Women's auxiliary, Mrs. R. G. Ingleson, and others were next in order.

The Exhibition Hall was formally opened by National Past President Robert G. Ingleson at 1:30 P. M. with appropriate remarks. Convention met again at 2 P. M. when reading of the reports of the various committees took place. These reports showed that the Associations are prospering and have bright prospects for the coming year.

About the only thing to cause a ripple out of the ordinary was the introduction of a resolution by the engineers of Cincinnati, which reads as follows: "We understand that the firemen will have a bill introduced in the next legislature to license firemen, and as we think, if this bill is passed, giving firemen full control of boilers under pressure, it would prove a source of danger to life and property and the public in general, we send this as a protest to the Ohio State Association, asking them to take action in regard to the matter."

After some rather earnest discussion the resolution was referred to the committee on license law.

Another resolution to be adopted was that requiring the regulation button of the Association to embrace the National colors, red, white and blue.

A grand ball at 8 o'clock Thursday evening, was one of the enjoyable features of the convention.

Friday the delegates and friends enjoyed an outing on the steamer Lakeside, which had been chartered for the day. The boat left the dock at 8:45 for Cedar Point, where the remainder of the day was spent as best suited the pleasure seekers.

Saturday morning the last session was called to order at 8:30 o'clock and the following officers elected for the ensuing year: President, R. A. Orin, East Liverpool; Vice President, Chas. Roth, Cincinnati; Secretary, Wm. Coon, Dayton; Treasurer, E. C. Johnson, Cleveland; Conductor, H. H. Forney, Barberton; Door Keeper, C. W. Hadlock, Painesville.

Saturday evening was devoted to a farewell reception and distribution of souveniors at Exhibition Hall.

The next convention will be held at Dayton, Ohio.

N. A. S. E. National Convention.

The twenty-fourth annual convention of the National Association of Stationary Engineers is to be held at Louisville, Ky., August 1 to 4, inclusive. The manufacturers' exhibit will be held at Liederkranz Hall.

Want Convicts to Mine Coal.

The coal miners interested in coal mining legislation now pending before the General Assembly of Illinois have been working for the passage of the measure equipping penitentiaries with printing plants and to do printing for the political divisions of the State and to get out school text books. An amendment has now been introduced providing that the convicts shall be employed in coal mines, to mine all the coal needed in State institutions.

"The board of prison industries," says the bill, "shall procure lands where coal mines are located in the vicinity or as near as possible to State institutions, either by purchase or by eminent domain, and also shall provide places to keep convicts when not at work in the vicinity of the mines, and there hereby is appropriated $100,000 to defray the cost of this amendment, which shall be paid out of the State treasury on vouchers of the board of prison industries, signed by the governor."

To find the capacity of tanks of any size in U. S. gallons the given dimensions of a cylinder being in inches: Square the diameter, multiply by the length and by .0034.

REPRESENTATIVE MEN FROM THE ENGINE ROOM, 23RD—John L. O'Brien.

John L. O'Brien was born at Chester, England, in 1862, and moved to Toronto, Canada, in April, 1876. There he served as an apprentice at steam fitting and worked at his trade until April, 1883, when he was offered a position as engineers' store keeper on a tramp steamer belonging to the Allan line of ocean steamers. He held this position until September, 1884, when he obtained employment on a steam shovel used in the construction of the Canadian Pacific railroad. After enlisting as a volunteer in the Queen's Own Regiment of Toronto, he served in the Canadian North West Rebellion against the Crees and Strong Indians. In the spring of 1893 he went to Chicago and obtained a position as assistant at the Armour Institution of Technology, taking up studies at the same time. In 1895, Mr. O'Brien obtained the position as chief engineer with D. F. Crilly, staying until January, 1904, when he received a call from the Civil Service, and has worked for the Chicago Board of Education up to this date. Mr. O'Brien is the working chief of the Chicago Council No. 1, of the Universal Craftsman Council of Engineers.

JOHN L. O'BRIEN.

The steamer William E. Corey, a duplicate of the Elbert H. Gary, the largest boat plying the great lakes, was launched June 24, at the yards of the Chicago Shipbuilding company. The Corey is one of the largest freighters in the world, being 569 feet long, 56 feet beam, 32 feet depth, and has a carrying capacity of 12,000 to 14,000 gross tons.

To ascertain the heating surface in tubular boilers multiply 2-3 the circumference of boiler by the length of the boiler in inches and add to it the area of all the tubes.

THE IDEA·EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

Disadvantages of the Three-way Cock.

Editor of the Engineers' Review:

I have noticed about every book and paper treating upon the use of the three-way cock condemn it and advise that it should be thrown on the scrap pile, as they say it is not reliable, and correct results cannot be obtained from its use. This may be so and in fact is so, but the thing the different authors neglect to state is why it is unreliable and not to be depended upon.

Engineers want to know when a statement is made, the reasons for making it, especially when the statement condemns a thing that thousands of engineers are using. For this reason I shall try to show why the three-way cock, with a single indicator is not advisable, and what the errors from using it are. There are instances where it is impracticable to use an indicator near each end of the cylinder, but such instances do not enter into the objections against the use of the three-way cock.

The three-way cock shown in Fig. 1, is used in connection with brass piping so arranged, that the cock is located midway of the engine cylinder. The steam as it passes from the cylinder to the indicator, when used in this connection requires a certain amount of time. This causes the indicator to operate sluggish in comparison with the movement of the piston within the engine cylinder, and the area of the diagram is therefore increased. The piston of the indicator being slow in responding to the changes of the steam pressure in the cylinder, is also a cause for enlarged area. This difference in the area of a diagram varies with the speed of the engine, being from 2½ to 6 per cent, as compared with cards taken with indicators connecting to the end of the cylinder by means of a nipple and single cock.

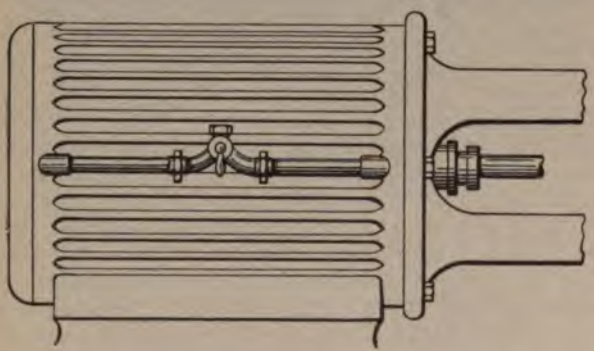


FIG. 1. CONNECTIONS OF A THREE-WAY COCK.

When the single cock is used as shown in Fig. 2, the full steam pressure of the engine cylinder is exerted upon the indicator piston without any loss of time, as the distance is so short between the cylinder and the indicator.

Not only does the three-way cock cause an increase in the area of the diagrams, but nothing can be told as to the action of the valves, unless they are out of adjustment so that the fact is apparent at first glance. Those having an indicator and in the habit of using the three-way cock, are aware that the cards taken with the cock in the center of the cylinder of the engine, are to all appearances good, and indicate that the valves are set right. If, however, the short connection is used and no other change is made, one will be surprised to find that the valve setting is considerably out, and that considerable adjusting will be necessary, before a card can be obtained, showing the valve action, as indicated in the cards taken with a three-way cock.

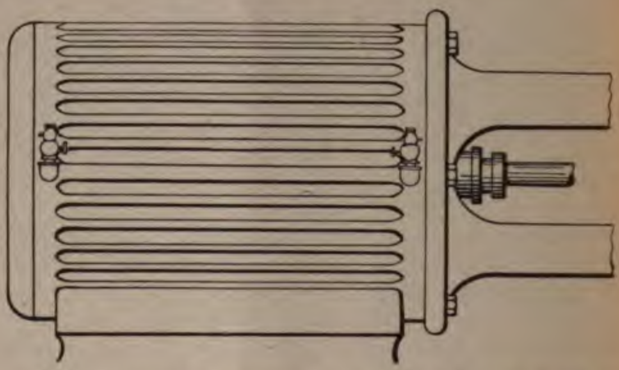


FIG. 2. SINGLE COCKS CONNECTED TO CYLINDER.

There is this then that the three-way cock is responsible for, an increase in the area of the card and a false record as to the action of the valves. If that is not enough to condemn the practice of the three-way cock, what is?

The only real thing that can be said in favor of the three-way cock is that it is most convenient.

T. Herrin.

Difference Between Back Pressure and Compression.

Editor of the Engineers' Review:

The letters which have been written about compression in several back issues of the Engineers' Review, have been interesting, and a good deal has been said about compression and back pressure, steam lines, etc. A good many engineers who are dabbling with indicator cards, confound compression and back pressure and do not seem to realize the difference between the two. There is a difference, however, and a great one, which must be known in order to read a card correctly.

In the arguments relating to compression, a fact seems to have been ignored, or not known, which is that compression gives back to the piston nearly as much power on the return stroke as was used in producing it, and if engineers who are discussing compression vs. non-compression would realize this fact, it l not be shrouded in so much mystery and there l be less discussion on the subject.

k pressure is the pressure which opposes the ment of the piston by the live steam and there- esults in the loss of power that could be used in effective work if there were no back pressure. is always a back pressure on the piston of an e, so long as the exhaust valve is open, allowing xhaust port to be in communication with the ler, but as soon as the port is closed, by the action valve, the back pressure ceases and compression s.

npression is the confining of steam in the cylin- hich is compressed by the piston driven by the pressure on the other side, and the momentum flywheel shaft, etc. As H. S. C. says on page the June issue, the crank on the dead center has verage for turning the shaft of the engine, and he power exerted on the piston at this time is y wasted and even after the crank has moved trifle out of the center the thrust is almost in a ht line, and there is very little if any turning developed. This is true, as all pressure on pins while the piston is within about 2 inches of nd of the cylinder produces excessive friction, loes no work. For this reason compression is to help equalize this pressure in bringing to rest oving parts. In fact it does just what H. S. C. ates, and does away with the lead which so many eers favor, by filling the clearance with steam ressure nearly as high as that in the steam chest. also saves loss in cylinder condensation, by main- g the walls of the cylinder at a higher tempera- than would otherwise be the case, provided no ression was used.

re we find compressed steam will produce effect- ork, because the power which it took to produce mpression is given back into work, less the fric- which is amply made up by the saving in the d state of the cylinder walls due to compression. s compression causes a greater pressure in the ler than that in the steam chest, it is of advantage ven necessary, especially in high speed engines. on the other hand, the less back pressure al- l on the cylinder of an engine the better.

twithstanding the arguments of Mr. Johnson and s that compression is not necessary, we know that s taken away, something must be introduced into linder to do its work in reducing the shock and n at each end of the stroke. Although one may le to get a card with a square corner by the ab- of compression, we know that if the compres- s done away with, the cylinder walls are cooled ive steam must be used to heat them. The result t the initial pressure will be reduced below that hat it should be if compression was allowed to lace, and more coal will be used in operating the e. I cannot see how any one can favor abolish- mpression when there is so much that can be said or of it.

N. L. H.

A Threadbare Subject.

r of the Engineers' Review:

seems that although Mr. C. B. Risley thinks the ct of compression threadbare, it is not enough prevent him from expressing his views. Mr. wants to know where the compression subject comes in and what there is to compress. In looking up the letter by W. J. D., I do not see that he refers to the low pressure cylinder as the one having the pound. He states that he moved the exhaust eccentric in order to relieve the engine of the pound, which it did.

It appears to me that there could be considerable compression on a card taken from the low pressure cylinder of a compound engine if the valves were set so as to cause compression, therefore, I cannot see where Mr. Risley is correct when he says that if there is anything to compress it is a vacuum. He certainly will get all the compression he wants to put on the engine from the high pressure cylinder, if he chooses, which added to the back pressure of the receiver, would make a material difference with the operation of that cylinder. With a low pressure cylinder, while the general run of cards would show the compression as taking place below the vacuum line, there is no law prohibiting the compression from running up far above, if the valves were so set, although it would be excessive and uncalled for.

Mr. M. A. Stedman has trouble with his governor pounding at intervals and is looking for information regarding the cause. As his engine operates quietly at times, it is evident that some particular condition arises to cause the pound. I would suggest that he look to his valve stem and eccentric to make sure that they work free without binding. It is possible that the valve stem has a shoulder, where it passes through the stuffingbox, which has been worn by tight packing. Such a condition could be where the shoulder only interfered when the engine was laboring with a heavy load, as when it was running light the throw of the valve stem would be less. A tight packing might also cause a pound to exist. If his governor is free from lost motion, etc., I would advise him to look to his eccentric, valve stem and valve.

In the May issue the article on "Foundations" did not have anything to say regarding the placing of generators or their base in position. This is something which is important, and while it is a simple matter, it is a subject which should be understood by every one who operates generators, both large and small.

Generators should be insulated on base frames, painted on the bottom with waterproof paint to prevent absorption of moisture. High potential machines, on account of their great weight and for other reasons, sometimes cannot be insulated from the ground. In such cases it is wise to surround them with an insulated platform made of wood supported by insulated supports and arranged so that a man can always stand upon it in order to touch any part of the machine. I know of an instance where this was neglected and very nearly resulted in the death of the dynamo tender. This happened in the city lighting plant in Chicago, where the engines were placed on the ground floor and the arc machines on the second floor. The dynamo tender while going about his duties came to a machine which had been grounded and although he placed his hand on a supposedly safe place, he was laid up for several weeks. The engineer happened to reach the second floor just in time to see him fall.

The frame of a generator should never be connected to the ground as in the case of a ground on the line the insulation on the winding of the fields is liable to give way, causing a short circuit. In case of a ground from the main winding to the frame, when the frame itself is connected to the earth, the strain will come upon the insulation of the line wires, and the weakest point in insulation is sure to cause trouble. If an insulated platform is built around the machine, which by the way is very seldom done, then when a ground occurs on the outside line, and also between the main winding and the frame, the operator is perfectly insulated from the ground. The attendant is also safer while handling the brushes, or any live part of the machine. When the generator and engine are direct connected, it is necessary that the frame be connected to the earth. It is better, however, when possible to maintain the insulation between the frame of the machine and the earth, both as regarding the risk to the machine itself and that of life.

L. M. Wentzel.

Compression.

Editor of the Engineers' Review:

I heartily agree with H. S. C. on page 10 of the June issue where it says that when one has finished reading about compression of steam in engine cylinders, he is about as much in the dark in regard to the advantages or economy of compression or no compression, etc., as when he began. One thing evident to all engineers who are acquainted with different types of engine is that engine builders, regardless of the type, do not recommend or advocate late admission of steam, as advocated by Mr. Johnson in a recent issue. In fact Mr. Johnson is about the only engineer with a few exceptions, that I have ever heard of, who advocate late steam admission, and the exceptions are as a rule men whose opinion one would not place very much reliance upon.

It seems strange that Mr. Johnson out of all the thousands of engineers who are operating every day should be the one to be right regarding this question and that all others, engine builders included, who have spent years in studying the question, should be wrong. It is evident to me that if there were economy in late steam admission and no compression, that engine builders would have found it out long ago and made it a feature of their engine. Such does not seem to be the case, however, and from that one thing alone, if from no other, we will naturally conclude that late admission is not the correct thing.

H. S. C. says he does not see the use of admitting steam to the cylinder when the engine is on a dead center as it is certain in that condition, the crank has no leverage for turning the shaft, and that the power exerted on the piston at that time is only wasted. Every one knows that there is no leverage when the crank is on the center, as the piston is simply blocked and the force of the steam is exerted on the pillow block through the piston-rod, crank-rod and crank. It takes very little movement of the flywheel, however, to get the crank off the center far enough to allow a leverage, when the steam in the cylinder will exert its power in useful work. I have turned engines from the center, or rather so near the center that a casual glance would cause one to think they were on the center, a good many times. By a measurement of the crosshead when on the dead center, and when the crank has turned far enough so that the steam will be able to turn the engine, there will be very little difference found between the two positions of the crosshead.

I do not believe in admitting steam too soon or before the piston reaches the end of its stroke, but I fail to see how any power is lost or enough to amount to anything by admitting steam when the crank is on the center. If there was no leverage in turning the engine from the center one way, there can be no leverage for an equal distance on the other side of the center, therefore steam can be admitted even before the center is reached without doing any harm as far as loss of power is concerned.

The old question of whether it is better to fill the clearance with live or compressed steam is a question which has never been settled to the satisfaction of all engineers, and probably never will be. For my part I prefer to compress to about half the boiler pressure before admitting steam into the cylinder.

I will confess that I have never operated my engines with late steam admission, and therefore, am not in a position to either uphold or condemn the practice, I cannot reconcile the idea, however, as being the ideal way of admitting steam to a cylinder.

It is plain enough to me that if an engine does not take steam until after it has passed the center, that by the time the port is wide open the engine piston is traveling at its fastest speed, and the initial pressure of steam does not reach the high point it should. This not only reduces the total amount of pressure in the cylinder during the stroke, but also reduces, in a measure, the expansive power of the steam.

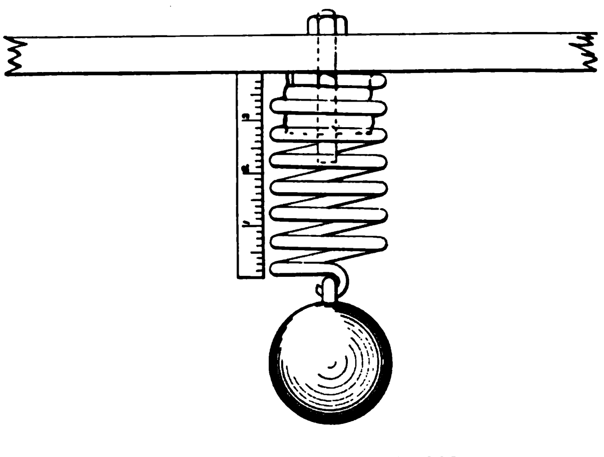
In conclusion I will say that I expect to keep on running my engine with a little lead and a little compression as formerly.

H. J. E.

Governor Springs.

Editor of the Engineers' Review:

One subject upon which little has been said is that of replacing governor springs in a two-spring shaft governor. Some adjust them by counting treads, others by the sound of the tension when the springs are struck with a hammer. Others leave one spring in and tighten on the other until the desired speed is secured.



TESTING GOVERNOR SPRINGS.

I have tried all of these ways when I have had to replace broken springs, but could not get the engine to run steady after two hours' work, I finally thought of the following plan of testing the springs and by it oon out of trouble. I secured a bolt threaded me as the spring end and passed it through the as shown, after jamming one thread. I then ed one spring on to the bolt as far as the jam-thread and placed a weight on the hook at the n end and measured the length with a scale the top of the spring to the bottom of the hook, the space between the turns. The same was with the other and I found there was quite a ence. By turning out on the bolt they were ht even. I counted the difference in the threads e I replaced them in the engine. I have seen springs that looked the same when tested and found to vary from ¼-inch in a 1½-inch length, ld ones more. When new ones are put to work old springs, one must be careful in getting the e to work steady.

en a spring breaks if four turns are left it can paired by taking the screw plug out with a pipe h and replacing it in the broken spring. When ok breaks it becomes necessary to heat and make one as it is too hard to bend cold.

D. F. Crowther.

Engine Friction.

r of the Engineers' Review:

e actual efficiency of an engine as a converter of nergy of steam into useful work can, in my opin- e measured correctly, only by means of the fric- r prony brake. The power shown by the brake in most instances, be less than that shown by ndicator by an amount equal to the frictional ance of the engine. When the indicator is used ws a diagram upon paper which shows the actual rmance of the steam within the cylinder and by lation, the average pressure upon the piston ghout the stroke is obtained, which multiplied e area of the piston and by the speed in feet per te, will give the total of foot pounds of work done e steam.

is includes the friction of the engine as well as seful work done, so it is evident that the horse- r as shown by the indicator diagram is not a ure from which to calculate the true efficiency of ngine. It is rather a measure of the quantity of consumed by the engine for each revolution, which may be calculated the amount of steam per horsepower per hour. The friction of an en- does not depend altogether upon the design or ruction, but the method pursued in the operation e engine has much to do with the efficiency, and ve little doubt, but that much of the friction, in y every engine which is operating, could be done with if the engineer gave his special attention to part of the work.

ke the matter of packing for instance. It is a known fact that any engineer can screw the gland piston-rod with sufficient force against the pack- that the friction caused on the rod will be so great make it smoke. Of course such friction is un- sary and should be guarded against, as the pack- s soon destroyed. A good fibrous packing should nt leakage without the gland being tightened up ght as is possible with a wrench. If attention is to this point considerable friction may be alle- d, and a better running engine will be the result.

Another way in which a good deal of friction may be prevented is through lubrication of the valves and piston. I have seen many letters published in engineering papers stating how little oil was used in the cylinders of their engines. I think it is a foolish idea to undertake to run an engine on too small a quantity of oil. It is easy enough to determine the proper amount of cylinder oil needed, whether the engine is large or small, by simply taking into consideration the kind of valves, whether they are slide valves, rotative, balanced or some other kind, as well as the speed of the engine, whether high or low, and as to the quality of the steam used, whether it is high pressure or low, moist or comparatively dry.

It stands to reason that a plain D slide valve requires more oil than a valve of the Corliss type, or a balance piston valve. Valves and pistons moving at a high rate of speed certainly require more oil than they would if running at a lower speed. It is also evident that steam containing very much moisture tends to destroy the lubricating qualities of the cylinder oil and therefore, a larger quantity of oil is required in such cases. It is useless to attempt to lay down any rule as to the exact amount of oil that should be used in the cylinder, but it ought not to take an engineer very long to be able to feed the right amount which any particular engine requires.

Naturally the revolving parts, such as the crankpin, eccentrics, main bearings and parts of the valve gear require attention. They also need just so much oil and no more, and as long as they run cool it is evident they are getting enough oil. If the engineer carefully looks after these items he will find that the friction of his engine will be materially reduced.

M. G. Wilbur.

Babbitting.

Editor of the Engineers' Review:

The usual method adopted in babbitting a box or a bearing is to first find out the thickness of babbitt or the distance the journal or shaft must be raised in order to have it level. After this distance is found it is only necessary to place the bearing in condition to hold the molten babbitt.

Some engineers in preparing to babbitt block up the journal or shaft with pieces of wood and then fill in the spaces between the blocks with fire clay or putty, so as to prevent the metal from flowing through those spaces. A more satisfactory way of doing the work is to level the bearing, and after finding the required thickness of metal, instead of using wedges of wood to support the journal or shaft in proper position, take

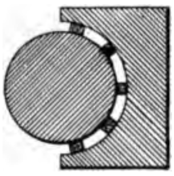


FIG. 1. SHAFT BLOCKED IN BEARING.

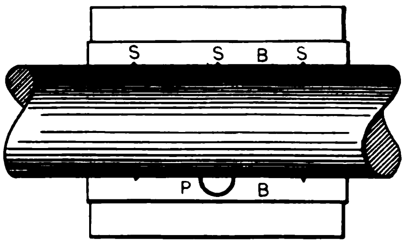


FIG. 2. PLAN VIEW OF BEARING.

a strip of leather the required thickness and form a collar between the bearing and journal. Referring to Fig. 1, the shaft is central in the bearing and resting upon the wooden strips, the spaces between the strips being filled in with putty or fire clay. It is evident that if we substitute strips of leather for the wooden blocks, a more perfect job can be done and a finished appearance is immediately given to the babbitt at the ends of the bearing and no further work is necessary.

Fig. 2 shows a plan view of a bearing about to be babbitted. The strips of leather shown at *B B* are fitted lengthwise of the bearing, and in these strips are cut the pouring space and air vents as shown at *P* and *S, S, S*.

Before pouring the babbitt, heat the bearing and journal in order to insure the babbitt flowing freely. Before babbitting the cap it must be separated from the babbitt in the bearing so as to prevent the cap babbitt uniting with it. This is accomplished by strips of oiled paper or card board placed lengthwise of the shaft and on top of the bearing, having the strips touching the shaft, and then pour the cap babbitt. It is also necessary to have the cap warm for the same reason mentioned above. Should the cap show a space at its ends this space or opening can be fitted with leather strips as before described.

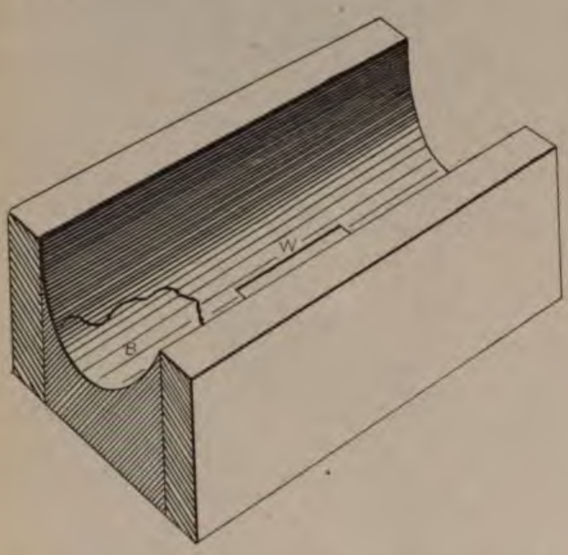


FIG. 3. SHOWING BROKEN PORTION OF BABBITT.

As a general rule the pouring will, if the cap is located in its center be filled with babbitt in the operation of pouring, which is allowed to remain permitting the adjusting screw to rest upon it, the oil holes are then drilled out. Before pouring, wooden plugs should be fitted into the oil holes reaching to the shaft, and drilling out the oil holes will not then be necessary.

A rather difficult job of babbitting came to my notice a few days ago. A box containing an oil well had the portion of the box supporting the babbitt broken, but not enough however, to discard the box, but enough was broken to make it a difficult job to babbitt. A piece of sheet tin was cut to size and bent to conform to the curvature of the bearing. The edges of the broken portion were then slightly coated with
putty and the tin was pressed into position. Af
was done the oil space was fitted with a soft pin
extending almost up to the surface of the babbi
insuring only a thin layer of babbitt to be re
Leather strips were placed in position at each
the box and the journal was allowed to rest upo
The sides of the bearing were then prepared as
described and the metal poured. After the b
sufficiently cool, the babbitt over the wooden
which filled the oil space was easily removed
cape chisel and the block split up and taken out
wick was put in place, the oil well filled, the
adjusted and the box is now giving entire satis
Fig. 3 shows the box with the wick space at
the broken part at *B*. There is one very e
point about babbitting that is generally ignore
that is, the cleaning of the surface on which t
bitt is poured. Oil especially is very objecti
The surface can be cleaned of oil by using
whiting or powdered chalk. If possible it will
rub over the surface with coarse sandpaper or
cloth. Wm. Kavan

Thinks the Statement Incorrect.

Editor of the Engineers' Review:

Mr. Vincent, in the April issue, says the adv
of an early release is apparent when an en
operated condensing. I cannot understand w
do not believe that the condenser will affect t
as he points out. Suppose an engine is operatin
condensing with 100 pounds steam pressure, o
pounds absolute, in the steam chest and exh
against 3 pounds gage pressure, or 17.7 poun
solute, making a difference in the pressures o
sides of the piston of 114.7—17.7 which equ
pounds pressure, while the steam valve is open
condenser is then started, and the exhaust
turned into it. The vacuum is high enough,
suppose, to remove 10 pounds of the origina
pressure. Then the engine exhausts against 17
which equals 7.7 pounds absolute.

Then drop the steam pressure 10 pounds, ma
90 pounds gage, or 104.7 absolute, so that th
sures on the opposite sides of the piston, wh
steam valve is open, will bear the same rela
each other as before. That is, there will be
ference in the pressures, on the opposite sides
piston of 104.7—7.7 which equals 97 pounds, th
as when running non-condensing. If the load
same, the card taken now will be exactly like t
taken in the first case. If the steam pressure ha
left as it was, the admission line would hav
shorter and the expansion line lower, making t
appear as it would if the steam had been rai
pounds when running non-condensing.

Of course while these cards compare and are
same shape, they will occupy different positions
paper from those taken while running cond
having a portion of their area below the atmo
line, and those taken while running non-cond
will have their whole area slightly above th
From Mr. Vincent's diagrams, one might suppo
the expansion line could not drop below the
pheric line, because the exhaust valve between
panding steam and condenser is closed. Mr.
is undoubtedly too well up in engineering subj
think so, but some engineers think that the

maintained by the condenser sucks, or draws, the exhaust steam out of the engine. The steam is forced into the condenser because of the difference in pressure in the cylinder at release, and the pressure in the condenser, just as it is forced to the atmosphere, when running non-condensing. How can the steam be sucked out of the engine, when suction depends on atmospheric pressure? The atmospheric pressure is used only to force in the injection water, which water, if you prefer to say, is sucked into the condenser.

I think Mr. Jarvis goes too far in his support of the "high and low water alarm," when he compares it to a safety valve, governor, sight-feed oiler, etc. In my opinion the alarm is of very little value, while the others are necessities.

What is the waterglass for? I presume that water is always within the range of the glass, when either alarm blows, so what is the good of the alarm? The careful attendant will keep the water at practically a constant level, and in case the water is getting down, he knows it without a whistle blowing in his ears to further annoy him, while he is doing his best to keep the water up.

Mr. Wakeman drives it to some of the boys pretty hard. He has had a good deal to say about piston travel and clearance. I wish to differ with him in his statement that "Keying up both ends of a connecting rod will change the clearance in some cases, but does not in others." In some cases the effect at both ends in keying up, is to lengthen the rod, while in other cases the effect at one end is to lengthen the rod, and at the other to shorten it. If both the wristpin brasses required the same amount of keying up, the distance between the centers of the pins, in the case of the latter rod, would never change, and consequently the clearance would also remain constant. But the wristpin brasses invariably require more taking up than the crankpin brasses, and the distance between the centers of the pins must change equal to the difference between the effects produced by keying up each end.

The engine which I am at present operating has this type of connecting-rod, and while the change produced in the length of the rod, by keying up is small, the rod in time lengthened enough to allow the nut that holds the piston on the rod to strike the bottom of the recess in the cylinder head, the clearance between the nut and the head not being as great as the clearance between the piston and the head.

The performance of Mr. Faber's simplex pump seems to be exceptionally good. With his length of discharge pipe and a good air chamber, the flow of water in the discharge pipe may be practically constant for the water, like any other moving body, resisting any changes in speed due to its inertia; yet I do not believe the water passes into the air chamber at a uniform speed.

In his last paragraph he says: "While the crosshead of an engine comes to rest at the end of each stroke, the belt on the pulleys travels just the same." The flywheel in the neighborhood of mid-stroke, speeds up a little above the average and stores energy, and then gives this extra energy in doing the work, or part of the work while the crank is on and near the dead centers, and in so doing drops a little below the average speed. So the belt doesn't travel "just the same," but near enough to be satisfactory.

Mr. Faber's comparison between the engine and the pump implies that the water, due to its kinetic energy received, during the most effective, or middle portion of the stroke, acts similarly to the flywheel and continues to flow through the pump while the pump is changing strokes. Although the water will do this to a very small extent when the pump is running fast, it comes so nearly at rest at the end of the stroke, and moves so rapidly at mid-stroke that the stream flowing into and out of the pump is a long way from being constant. Motor.

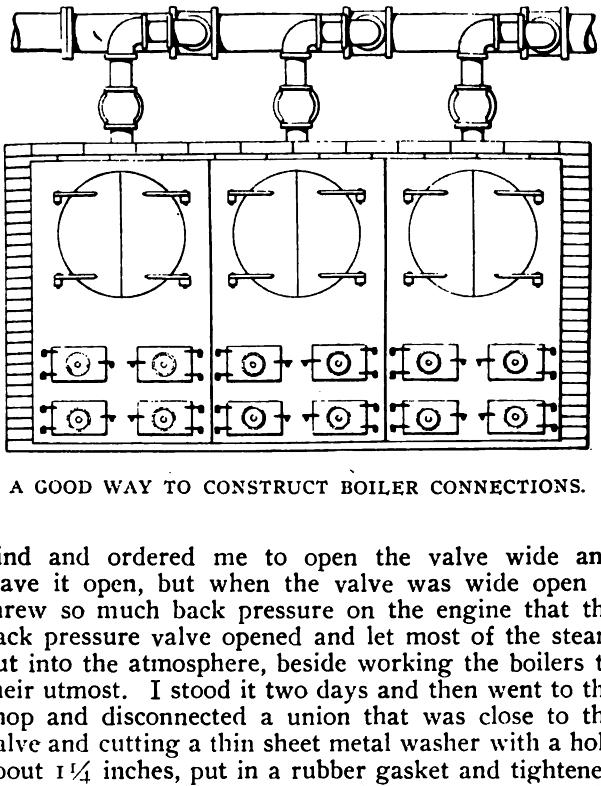
Boiler Connections.

Editor of the Engineers' Review:

In answer to question 387 appearing in a recent issue a sketch is produced showing the pipe connection to three boilers. In my way of reasoning the illustration shown below is a better way as it allows for more expansion.

Speaking of engineers deceiving their employers, most all engineers have done so at some time or other. I was recently employed as engineer in a plant where we heated the shop by exhaust steam, but in very cold weather the exhaust was not enough, so I had a 2½-inch live steam pipe to help out and to use when the engine was not running.

The superintendent was one of the "know-it-all" kind and ordered me to open the valve wide and leave it open, but when the valve was wide open it threw so much back pressure on the engine that the back pressure valve opened and let most of the steam out into the atmosphere, beside working the boilers to their utmost. I stood it two days and then went to the shop and disconnected a union that was close to the valve and cutting a thin sheet metal washer with a hole about 1¼ inches, put in a rubber gasket and tightened it up without the "super" knowing anything about it. He saw that the valve was wide open and was satisfied and I had no more trouble. A. H. Armstrong.



A GOOD WAY TO CONSTRUCT BOILER CONNECTIONS.

Velocity of Water When Blowing Down a Boiler.

Editor of the Engineers' Review:

I am an interested reader of your paper and in a late issue I noticed Mr. Bennett's article about the danger of the sudden opening, or closing of the blowoff valve. The necessity of caution that the article implies is good, but the mathematics are at fault. He states that steam at 100 pounds pressure, blowing into the air, has a velocity of 1,900 feet per second and then assumes that water under the same pressure would discharge through the blowoff at the same velocity. If that were true we would hardly dare open the blowoff valve at all. To consider the case, suppose a boiler 5 feet in diameter and 16 feet in length, neglecting the flues, would have a cubic contents of 5x5x.7854x16=314.16 cubic feet. Taking it as ⅔ full of water would give 314.16x⅔=209.44 cubic feet of water in the boiler. Now in a pipe 3½ inches in diameter and 1 foot long there would be 3½x3½x.7854÷144x1=.0668 cubic feet. Then a velocity of 1,900 feet per second would give .0668x1,900=126.92 cubic feet per second discharge. It would then require 209.44÷126.9=1.6+ seconds to empty the boiler.

Assuming the conditions as he has of a straight pipe 8 feet long engine at the blowoff valve, the velocity of discharge is found by the formula, $2.315\sqrt{\frac{h\,d}{fe \div .125d}}$ *h* being the equivalent head in feet equals, 100÷.434=230.4 feet, *f* being coefficient of fraction taken as .025, *d* being diameter of pipe in inches, *e* being length of pipe in feet. Then the velocity of discharge= $=2.315\sqrt{\frac{230.4\text{x}3.5}{.025\text{x}8+(.125\text{x}3.5)}}=82.32$ feet per second.

The weight of water in a 3.5-inch pipe, 8 feet long equals 3.5x3.5x.7854x.434x8 equals 33.6 pounds. The energy in 33.6 pounds of water moving at rate of 82.32 feet per second equals 33.6÷2x32.16x82.32x82.32 equals 3,522 foot pounds.

Mr. Bennett expresses his results in pounds which is not right, for the force of the blow in pounds is determined providing rupture does not take place, by the amount of elongation of pipe and how much it is distended circumferentially, for iron is elastic within certain limits. To make the idea clear, suppose a bullet to impinge upon a board and penetrate to a certain depth. The pounds pressure of the bullet on the board depends upon the hardness of that board, the energy of bullet being gradually expended. If the board were twice as hard, the bullet would have penetrated but half as deep, but the pressure of the bullet on the board would have been twice as great, while the work done by the bullet would have been the same in each case.

Charles B. Miles.

Has a Different Opinion.

Editor of the Engineers' Review:

I have read with interest, the different reasons given for the bulge in the mud drum of the boilers illustrated by F. H. and answered by C. E. Bome, who is the last one to express his views. He thinks the bulge is caused by air collecting, thus preventing the water from reaching the plate. While this may be the reason and is possible, I do not think it is the true solution of the trouble. It is more likely a fault in the plate known as lamination, which is something that no man could prevent except the maker of the plate. I would suggest to F. H. that he have the bulge cut out and patched before serious results occur.

The letter by "Observer" was interesting to me as it carries further the discussions which have arisen regarding smokeless stokers. "Observer" makes a statement that while I do not doubt it is so in his case, it is something I have never yet seen. He says he can take Mr. Bosworth where there are more than one make of stokers which he has previously mentioned, where the boilers are frequently forced 50 and in some cases 100 per cent beyond the rated capacity without their being any smoke.

I think that such cases must have occurred where the coal consumed was of a kind which would make little smoke under ordinary circumstances when hand firing, but with such coal as is commonly used in the middle West, I have as yet failed to see a stoker that will produce a smokeless chimney under ordinary conditions. What I mean by smokeless chimneys is one where no perceptible smoke can be seen issuing from its top.

Since reading "Observer's" letter I have noticed more than ever stacks of different plants which are equipped with stokers, but I have failed to observe one yet which does not smoke more or less. I do not say that they are being operated as they were intended, but I suspect that they are. I know that the engineers in charge are capable of getting smokeless stacks if it is possible, and if it is possible, why don't they do it? From my plant I can see the stacks of several boiler rooms and none of them are what I call smokeless, although they are equipped with stokers. I know that stokers will prevent smoke to a great degree, but I have never seen them operate where there was an absence of smoke such as would be expected when speaking of smokeless firing.

L. G. R.

High and Low Water Alarm and Other Things.

Editor of the Engineers' Review:

There have been a number of high and low water alarms described in your paper at different times. As to the benefits or otherwise derived from their use, we will leave that out of the question. Many engineers are firm believers in them, while many more are not. The enclosed sketches show how an electric high and low combined water alarm operating an electric bell can be arranged to either the top of a boiler, as in Fig. 1, or to a water column made out of a piece of 4-inch iron pipe in Fig. 2. The rod attached to the float is of very small diameter and the packing is well soaked in oil and ground graphite thus having very

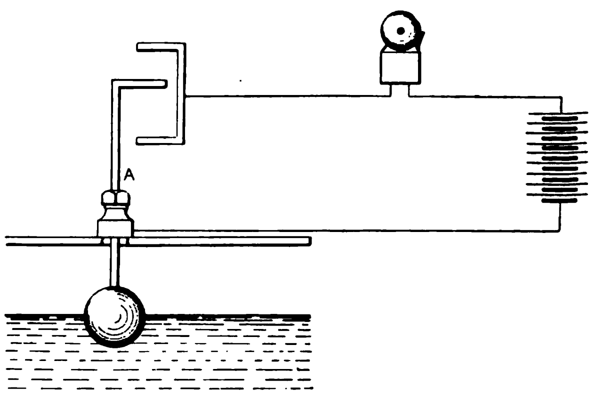


FIG. 1. ELECTRICAL HIGH AND LOW WATER ALARM.

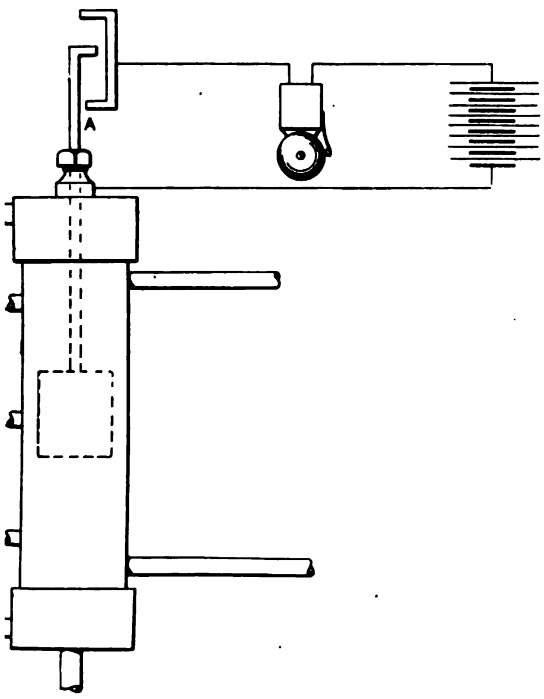
riction on the rod *A*. The operation of the is apparent and no description outside of the is required.

ay be news to some to know that rain water es iron faster than water containing lime or sia, the carbonates being the best preservatives. vater sometimes contains acids in a very slight , derived from smoke and soot upon the roofs dings or from the smoke of chimneys.

y engineers advocate using sugar in boilers to scale, and as some engineer may be inclined to s plan it may be worth while to point out that sugar will remove scale, it will also dissolve the eely.

ineers often ask for a paint for boiler fronts. ır and ground graphite thinned with turpentine an excellent paint for boiler fronts and smoke The steam pipes, if used for heating should only very thin coat of lampblack and linseed oil.

make a permanent joint on a flange or where on faces, rough or smooth, come together, will stand fire, steam or water, mix mineral as- and white lead to make a stiff putty. Place of the mixture between the iron surfaces and them together. When this sets, it is just the is one piece of iron.



ELECTRICAL HIGH AND LOW WATER ALARM CONNECTED TO WATER COLUMN.

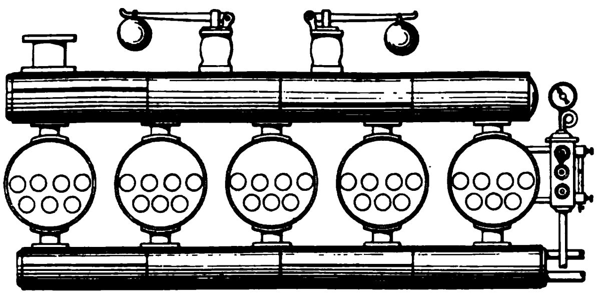
aps it would be interesting to engineers to that wet rope has only about one-third the ten- ength of the same rope when dry, and that a turated with grease or soap is still weaker, as ricant permits the fibers to slip with greater A dry rope 25 feet long will shrink about ot on being wet. Scotty.

A Peculiar Battery of Boilers.

Editor of the Engineers' Review:

I am sending you a sketch of a very peculiar battery of boilers which have recently been brought into this country, (British Columbia) from the United States, by a large saw mill company, and the way they contemplate installing them is, according to my idea, one of the most foolish arrangements in the engineering line I ever saw.

The manager of the company says these boilers have been in operation in the state of Wisconsin for about two years, but I am certain the inspectors won't allow the boilers to be set the same way here. There are five boilers in the battery, 48-inches in diameter and 16 feet long, with 10, 6-inch flues, flanged to the heads in each boiler. They rest on a mud drum at the rear end, while the fronts are hung from two I beams, which are 30 feet long and rest upon the two side walls which are 20-inches thick.



PECULIAR SETTING OF BOILERS.

On the top, running full length of the battery, is a dome or receiver, to which the connections and safety valves are flanged. The boilers are all fed by the one pipe which enters the mud drum through the bottom pipe as shown. There are no stop valves between the mud drum and the boilers, or between the steam drum and boilers, consequently instead of five boilers, if I may use the term "there is only one," especially as there is no dividing wall between the boilers. To wash out one boiler or to make any repairs to it, anyone can see that all would have to be emptied. I can imagine what would happen supposing a bad leak should occur in a flue of one boiler.

The diagram gives a fair idea of how the boilers would look if the boiler inspectors allow them to be installed that way.

Will some good practical engineers give their opinions on this up to date plan? I might add that in contrast to the boilers, the engine is a 22 x 48 inch Allis Corliss. G. M. B.

Inspectors.

Editor of the Engineers' Review:

The letter by M. E. Webber on page 21 of the June issue attracted my attention and induced me to write this letter. He says among other things that there is no doubt but that boiler inspectors do a great deal of good and many times force owners of steam plants to make repairs that never would be made otherwise. This is a point which should be emphasized more than ever, and a few figures given to show that there is no doubt, but that boiler inspectors do a great deal of good. I want to give a few figures and facts which I have taken from the April issue of "The Locomotive," which I receive, to show that a good deal depends upon the inspector, and at the same time to give a general idea of what might have happened had there been no inspector. The report given below is a summary of the Hartford Steam Boiler Inspector and Insurance Company's inspectors' reports for the year 1904:

"During the year 1904 our inspectors made 159,553 visits of inspection, examined 299,436 boilers, inspected 117,366 boilers both internally and externally, subjected 12,971 to hydrostatic pressure, and found 883 unsafe for further use. The whole number of defects reported was 154,282, of which 13,390 were considered dangerous. The usual classification by defects is given below:

SUMMARY, BY DEFECTS, FOR THE YEAR 1904.

Nature of Defects.	Whole number.	Dangerous.
Cases of deposit of sediment....	16,994	902
Cases of incrustation and scale..	42,126	1,014
Cases of internal grooving......	2,820	258
Cases of internal corrosion......	13,167	671
Cases of external corrosion......	10,455	723
Defective braces and stays......	2,286	588
Settings defective..............	5,877	480
Furnaces out of shape..........	6,686	278
Fractured plates	3,983	614
Burned plates	5,642	566
Blistered plates	1,148	107
Defective rivets	3,374	660
Defective heads	1,511	194
Leakage around tubes	11,986	1,821
Leakage at seams	6,581	403
Water gauges defective	3,752	696
Blow-out defective	4,146	1,179
Cases of deficiency of water.....	290	133
Safety valves overloaded	1,348	403
Safety valves defective	1,364	350
Pressure gauges defective	6,666	425
Boilers without pressure gauges.	350	350
Unclassified defects	1,730	574
Total	154,282	13,390

"The following table shows that our inspectors have made over 2,000,000 visits of inspection, since the company began business, and that they have made more than 4,000,000 inspectors, over a million and a half of which were complete internal inspections. The hydrostatic test has been applied in more than 200,000 cases. Upward of two and three-quarter millions of defects have been discovered and pointed out to the owners of the boilers; and nearly 300,000 of these were, in our opinion, dangerous. The number of boilers condemned by us as unfit for further service is practically 17,000, good and sufficient reasons for the condemnation being given in each case."

GRAND TOTAL OF THE INSPECTORS' WORK SINCE THE COMPANY BEGAN BUSINESS, TO JANUARY 1, 1905.

Visits of inspection made................	2,128,969
Whole number of boilers inspected........	4,161,396
Complete internal inspections............	1,615,666
Boilers tested by hydrostatic pressure......	211,022
Total number of defects discovered.......	2,861,581
Total number of dangerous defects........	296,550
Total number of boilers condemned	16,985."

If the above does not show that inspectors do some good, it surely will be a difficult matter to produce facts which will.

G. H. Houser.

Boiler Explosions.

Editor of the Engineers' Review:

The many boiler explosion disasters throughout the country during the last few months, especially that of the Brocton case, has attracted considerable attention to boilers from engineers and presumably boiler makers and inspectors. We know just as long as steam boilers are used, just so long will boiler explosions take place, and probably the majority of such accidents that will occur in the future will be through the crystalization of the plate, or a hidden crack which can seldom be determined until too late.

Many boiler explosions have taken place, which have been due to the non-operation of the safety valve. We all know it is no uncommon thing for a safety valve to stick until the pressure rises 10 or 15 pounds above that at which the valve is supposed to blowoff. When the valve finally releases there is a rush of steam with a corresponding eruption of water on the inside, which is a condition that many boilers are not able to stand and therefore an explosion takes place.

Crystallization of the boiler plate is another cause of boiler explosions. By crystallization we mean, that the steel plate has been changed to that of an ordinary grade of cast iron, which is effected by burning, usually caused by the presence of scale or mud. This is something that is hard to determine, because there is no wasting away of the material or other signs of deterioration.

Another cause for boiler explosions is that of sheared rivets or rivet weakness which is the result of an excessive contraction and expansion brought about by sudden and too great changes of pressure, or an irregular change in the water line together with the evils which are brought about by cooling off a boiler, or heating it up too suddenly.

Another cause is that of scale, when it is allowed to accumulate around the rear heads and tubes in such quantities as to prevent the water from reaching the metal. When such a condition exists the ends of the tube projecting through the rear head are exposed to the flames from the furnace, and are soon burned so as to loose a greater part of their holding capacity. When this takes place, the fibre of the metal is destroyed and the pressure on the inside of the head will force the heat out, causing leaky tubes. Rolling of the tubes will be of little avail in such a case and the only remedy is to retube the boiler. If the burning of the tube is sudden and at the same time severe the boiler head is unsupported to a great extent and consequently an explosion follows. I have seen many cases where it is a wonder to me how the heads ever stood the pressure carried, with the tubes in the condition they were.

I remember one instance, of a boiler having 80 some odd tubes in which over half were leaking at the rear head, while a broken stay on the same end added to the unsafe condition of the boiler. When we examine some of the old boilers that have been thrown out of use, and see the condition they were in when last operated, we wonder how they ever held together, to be removed by human agencies.

L. S.

More About Handling Boilers.

of the Engineers' Review:

not agree with some of the statements made by
nt writers in the columns of the Engineers'
v in which they state that engineers are found
ine rooms who know nothing about the care
lers. It doesn't stand to reason, if the man
osed to have ordinary intelligence, that he can
arge of an engine and know nothing about the
plant. I do not believe that a man who knew
g about boilers could get a position as engineer
it happened that he was operating in an engine
nder the eye of a chief engineer who did know
iness.

Weber in the June issue gives us an example
ignorance of a fireman connecting two boilers
er, having a difference in pressure of 35 pounds.
this is something that I would not advocate
is no worse than many other instances which
be rightfully attributed to engineers who are
ed to know things. It seems that the engineer
ds up to us, was not attending to his business,
allowed the fireman to get up steam in a boiler
ter a few hours returned to the boiler room to
w things were coming on. If that engineer
red that he had a fireman who was so ignorant
oilers that he did not know enough to cut them
was his business to come around more fre-
than once in a few hours. If the fireman was
rant as cited, he was hardly a fit person to get
am in a cold boiler in a proper manner. For
t I think the faults of the modern engineer and
could well be dropped and more said of his
. He has plenty to be commended and it ap-
o me that it would be far more instructive and
le matter, than this everlasting telling about
lts and shortcomings, ignorance and stupidity.
are many virtues which are possessed by en-
and firemen, honesty being one of them which
wn by the following clipping:

nis Mulvihill, who three years ago, from a
in an east-side factory, became Mayor of
port, Connecticut, has had a bill prepared for
tation to the Legislature, providing for the re-
of his salary by one-third. The salary is

is Mayor's job is easy,' he says. 'I never had
work in my life. The salary is much too high
,000 could be cut off from it and it would still
icient. I spend all my time in the interests of
y and believe that I have been overpaid for my
s. I want the Legislature to cut it down to
'"

what's the matter with Dennis? F. H. King.

Making Smoke.

of the Engineers' Review:

question of making smoke seems to be coming
front and although I can agree with much that
en said on this subject, I do not think many of
uments will hold water under all circumstances.
e are many engineers who do not care whether
tack produces a volume of black smoke or not.
mber when I first started engineering some 10
go, I thought it a fine thing to make as much
come out of the stack as possible, even going so far as to stir up the fires in order to get the smoke pouring out of the stack. Since then I have found that this was a waste of fuel, but at the time I cared little about that feature of the problem. There are a good many engineers who, although they know that there is a waste going on when black smoke is made, do not care very much about the matter.

There is plenty of soft coal mined which will burn in a properly constructed furnace without smoke, and I have been fortunate enough to burn considerable of it in my time. I know that the way in which coal is fired has a good deal to do with the question of smoke and I also know that if more care was taken in firing, that there would be less smoke than there is. We engineers do not have to be told that smokeless firing is an impossibility, and that while coal is burned there will be smoke. We know it, but at the same time we know there is more to the question than the kind of coal, or an imperfectly constructed furnace.

The source of a great amount of smoke is due to the way in which the firemen do their work. It is not always the large plants that are the guilty parties, for I have seen more smoke come from small heating plants, than from some of the large power plants. The reason is that the engineer or fireman allows the fire to get low and then has to hustle in order to get the fire in shape to keep up steam. It is the constant firing and stirring that causes a great deal of the smoke.

I see that Slim Jim thinks that a man cannot be an engineer unless he can go down into the fire room and shovel coal. I know of many engineers who do not go into the fire room, from one week's end to another. It isn't their business to do so, as the boilers are under the care of a chief fireman who is supposed to know his business to attend to it, as the engineer attends to his.

The engineers are successful, however, and do not seem to have retrograded in the least, from not keeping up their practice in shoveling coal and ashes. In small plants the engineer has more to do with the boilers, and I suppose that in case of his getting a fireman who does not know his business, that it would come in handy to know all about the boilers and how to fire them. I think T. E. C. is right when he says that a man can be successful as an engineer and not know so very much about firing. Jim Slim.

The Blowoff Pipe.

Editor of the Engineers' Review:

On page 23 of the February Review, L. S. Saunders informs us that in all his experience he has never had a serious breakdown. He then relates an experience with a blowoff pipe that certainly came very near to being a serious one.

He states the blowoff pipe on one of his boilers became stopped up and although the boiler had been without steam in it for 15 hours, and therefore must, of course, have been comparatively cold, he admitted steam from another boiler into the cold one. It seems to me the best way under the circumstances, would have been to have opened the valve on the feedpipe and filled the boiler with water, and thus have obtained the necessary pressure to have cleared the obstruction from the pipe. The strain on the boiler would have been less, and if the blowoff pipe had broken off, no serious trouble would have resulted.

Two or three letters about "Wrenches on Valves" have attracted my attention. I believe that this is a matter in which it is necessary to display good common sense, and if an engineer does this much, hard work will be avoided and no harm will result.

In a large plant there are many cases with large valves where it is absolutely necessary to use something besides the hands to close a valve tight, unless the wheel is made unduly large. What ought the engineer to do in such a case? Pull on the wheel until his strength is exhausted, or find a wrench and close the valve just right? The latter he will be able to do if he is practical. The practical man soon gets the "feel" of that, as he does of other things, such as screwing up studs, nuts, etc. Of course no one would think of applying a large wrench to a small valve, if he used reason. If he does such an impractical thing, the steam plant is no place for him. S. J. Smith.

Handy Fire Room Tools.

Editor of the Engineers' Review:

Very often boilers are so constructed that while cleaning fires, only one of the furnace doors is open at a time. Instead of the longer and heavier lazybar resting on top of the hinges of both doors, as is the usual custom when cleaning fires, an improvement has been made to prevent the surplus of cold air passing into the furnace as it does when both doors are open, and the longer lazybar is used. I made provision to alleviate this, by securing to the bolt of the door frame a piece of iron ¼-inch thick and 1½-inches wide and made like *E*. This answers to hold one end of the lazybar, and remains in its fixed position permanently. For the lazybar a piece of ¾-inch bar iron was made like *F* and shown in position by the dotted lines, Fig. 1.

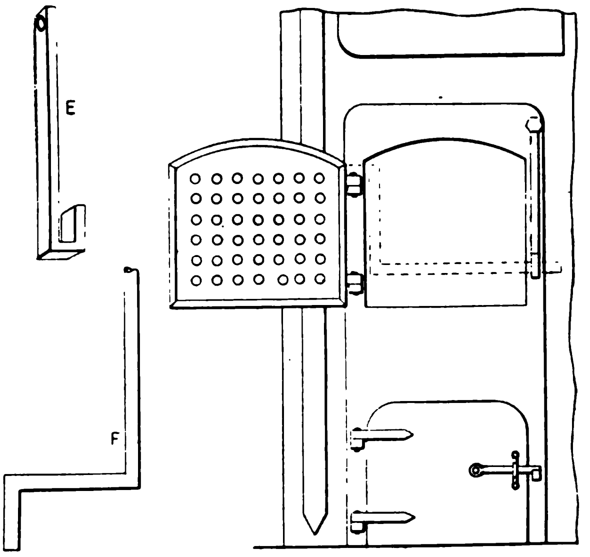


FIG. 1. LAZYBAR IN POSITION.

Where I am employed, No. 2 buckwheat coal is used and a hoe suitable for that grade of coal was made by using a piece of iron, $\frac{5}{16}$-inch thick by 6½ inches wide and 13 inches long as at *H*, Fig 2. A ¾-inch malleable railing flange fitting, *J*, was rive the hoe blade and a 1-inch pipe the required threaded at both ends was made up as shown with a reducing coupling and a piece of iron th to fit. The iron was bent to fit the hand. This a very substantial hoe. Jas. G. Sheri

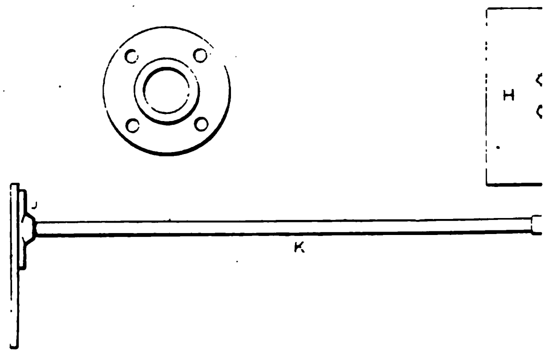


FIG. 2. A CONVENIENT HOE.

Valves in Water Column Connections.

Editor of the Engineers' Review:

I am very much interested in the way the bc taking up several questions of late. Considerat been said about water columns, especially about between the boiler and the column. I can't see the valves do any good. I have a boiler with but have never had any use for them yet, ai boiler has been in constant use since 1896. S as there is a valve above the gauge glass and bı can't see any use for other valves.

In my boiler I use coal oil and sal-soda, wi results, but I think the best compound, when the gets badly scalded is to take the tubes out ani you have a good chance to clean out the boiler A. Rossbach,

Pipe Plugs.

Editor of the Engineers' Review:

I find on page 17 of the March Review "Saw article in which he speaks of the "little warts" ends of pipe plugs and his method of overcomi difficulty of turning the plug by the little "\ His way is very good, but if he will try my think he will find it a better one.

My plan is to get a bushing the size of the wish to plug, put a plug in the bushing and them both into the tee or elbow. When I w remove them, I can do so by taking hold shoulders of the bushing with a monkey wrench shoulders of the bushing being large, enables get a good firm hold without cutting off the c which the wrench would certainly do to th "warts."

I am running a plant in which our feedwat enters the boilers near the lower edge of the froı sheet. The pipes bothered about liming up they enter the boilers. There was an elbow i pipe about 6 inches from the tube sheet, and ir to remove the lime from the pipe I was obli reach in through the manhole and clean the ipe from the inside of the boiler. I soon got of this way of doing, so I took the pipes apart removed the elbows, replacing them with tees tted them with bushings and plugs, as explained . Now I can remove them and by driving a er gas pipe through the larger pipe, remove all ollected in it, with but very little work.

Smut Face.

Steam Pipe Lines.

r of the Engineers' Review:

hough the article in the May issue entitled m Plant Piping," contained considerable inforn regarding the matter, I have ventured to write llowing, which seems to me, are the main prin- underlying good steam pipe design. The first, ne which is often violated is that of carrying the from the boilers to the engines, by the shortest cal way, and at the same time allowing ample for the engine. When the pipe is large enough, essary losses in pressure and high velocities will ided. To successfully construct the steam pipe rovisions must be made for expansion and contraction of the pipe. Suitable support and anchoring is necessary to avoid vibration.

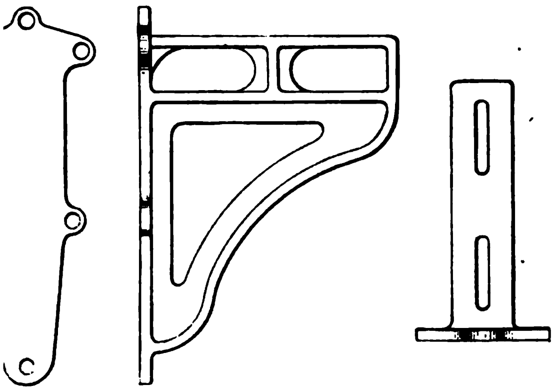
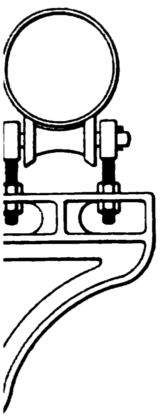


FIG. 1. WALL BRACKET.



2. BRACKET AND AD-STABLE SINGLE ROL-R.

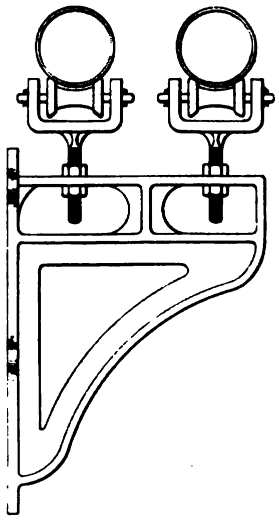


FIG. 3. BRACKET AND ADJUSTABLE DOUBLE ROLLER.

Probably one of the great faults in steam plant piping is lack of a thorough drain system, to allow the condensation to return to the boilers. In others, proper joints and packings are not used, while most steam pipe lines have more valves in them than necessary.

Modern steam plants we find are designed in two ways. The engine and boiler room are located side by side, or the engine and boilers are placed back to back, having a fire wall partition between them. The latter method, allows of the shortest piping possible between the engine and boiler, or from the boilers to the main header from which the steam pipes of the engines are taken. The header is usually placed in the boiler room, because if any accident happens to it, the engine and electrical apparatus will be protected against serious injury.

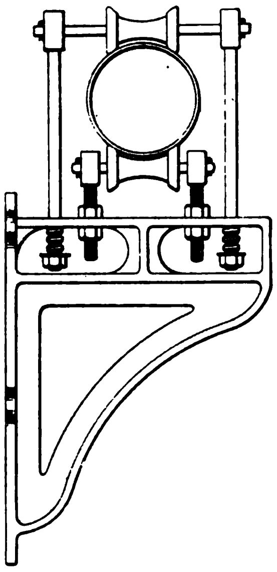


FIG. 4. ADJUSTABLE ROLL AND BINDER.

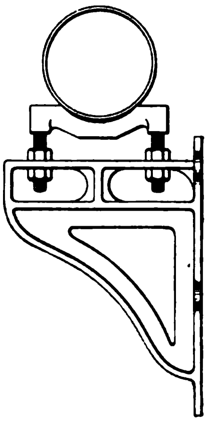


FIG. 5. ADJUSTABLE CHAIR.

The proper anchoring and supporting of large steam mains is most important. It is preferable to allow the system to expand in the proper direction without stress and at the same time avoiding vibration. The following illustrations will give an idea of the method used in supporting pipes and allowing for expansion. Fig. 1 shows a wall bracket upon which the rollers supporting the pipe and allowing for the expansion and contraction are attached. Fig. 2 shows a bracket with an adjustable single roll, which may be adjusted to suit the pitch of the pipe at the same time, allow the pipe to expand.

Fig. 3 shows the bracket with two adjustable rolls which are designed for pipes smaller than that shown in Fig. 2.

Fig. 4 shows an adjustable roll and roll binder. It will be seen that the tension of the roll binder on the pipe is secured by means of a spring shown between the upper cross section of the bracket and the roll rod nuts.

Fig. 5 shows an adjustable chair which is sometimes used instead of the roll.

A method of anchoring a pipe in order that the expansion shall be in the direction desired is shown in Fig. 6. It will be seen that the pipe is firmly gripped in the clamp, which in turn is secured to the bracket, thus preventing any movement in the pipe due to expansion.

Fig. 7 shows the solid anchor. In this instance the pipe rests on the chair or saddle and is gripped by means of the rod which is shown passing over the top, and secured to the wall bracket.

Much might be said regarding duplicate pipe systems, both for and against. The general practice is coming to be that of subdividing into units, while in smaller plants the duplicate system is used. The service and conditions govern the method of piping, which should be such in every instance as to prevent a shut down due to accident in some part of the system. It has been found that with large auxiliaries in the larger stations, separate headers are used to advantage, which allows the main header to supply a more uniform velocity of steam in the header to the engine. This also allows the numerous pipes required for auxiliaries, etc., to be taken from the smaller header.

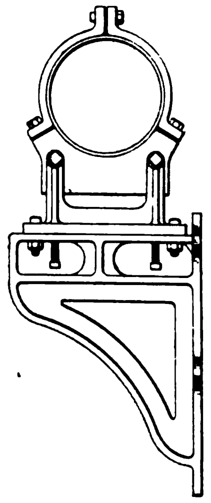


FIG. 6. ANCHOR FOR PIPE LINE.

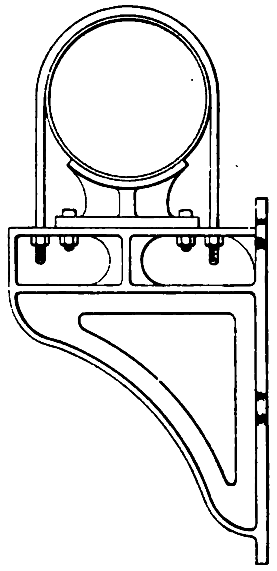


FIG. 7. SOLID ANCHOR.

There probably has never been a pipe system constructed yet where the engineer in charge, or the designer, did not realize that there were parts which might have been improved upon. It is especially important and necessary to give pipe construction every consideration. L. M. Kelly.

Horsepower and Steam Consumption of a Compound Pump.

Editor of the Engineers' Review:

I have noticed considerable space given to the figuring out of the horsepower of engines and boilers since I began taking the Review, some years ago, but little if anything has been said as to computing the horsepower or steam consumption of a pump, especially of the compound type. In my plant we have a Worthington compound duplex pump and the way we figure out the steam consumption per horsepower is
lows, although it is really only an approximat
mation of the steam consumption at best:

The initial steam pressure is 105 pounds, with
minal pressure of 33 pounds in the high pressure
der. We take what seems to be the simplest
of finding the horsepower and first determin
actual amount of work done by the pump, in or
find the actual horsepower developed. This is fo
multiplying the pressure developed, by the he
water, by the area of the pump plunger, and t
the total speed per minute of the two plungers a
vide by 33,000. The pump has a 12-inch strok
plungers 10 inches in diameter, running at a sp
25 revolutions per minute against a head o
pounds per square inch. The area of a 10-inch
would be 10 × 10 × .7854 = 78.54 square i
The total speed of the plunger will be 100 fe
minute. The actual horsepower would be
78.54 + 100 ÷ 33,000 = 26.18.

The initial pressure of the high pressure cy
is 105 and the cutoff takes place at about half s
This cylinder has a diameter of 14 inches and
sectional area of 153.94 square inches, nearly.
a 12-inch stroke there will be 153.94 × 12 = 1,
cubic inches, 1,847 × 25 = 46,182 cubic inc
steam used per minute.

A cubic foot of steam at a pressure of 105 p
per square inch above the atmosphere weighs
.2759 pounds, and the weight of steam used pe
ute would be .2759 × 26.73 = 7.37 pounds, or
pounds per hour. 442.2 ÷ 26.18 = 16.8 poun
horsepower per hour.

The article on "Foundations and Chimneys"
May issue was instructive. The relative size
sectional area boiler flues and chimneys is of
est to engineers, and probably lack of area is
causes a good deal of the trouble with poor dra
There is some variation in the practice regardi
relative area of chimney and boiler flue area
has been said it is good practice to use the grat
as a basis for both. The cross-sectional area
tubes of a steam boiler should not be greate
2-9 or less than 1-8 of the area of the grates;
a proportion commonly used. The main flue b
the boiler and the chimney should have a cross-
of from 1-3 to 1-5 the area of the grate area.
sectional area of a chimney depends upon the
of the chimney and upon the grate area.

One method of determining the area of the
section of the top of a chimney in square feet
average rate of combustion is

$$\frac{\text{Area of grate surface in square feet} \times C}{\sqrt{\text{height of chimney}}}$$

In which $C = 1.82$ for a chimney for one boil
$= 1.52$ for a chimney to range from two to six b

We recently put up a stack on a self supp
foundation and I amused myself by figuring o
proper size of anchor bolts for the chimney.
stack is 65 feet high and 28 inches in diameter.
thing was to find out what the pull on the bolts
be and then get bolts strong enough to stan
strain. The height × the diameter gives th
exposed to the action of the wind, or about 152
feet. Figuring the maximum wind pressure to
pounds which would be ample for a round chim
the wind pressure is about half of that on flat
neys, we have 152 × 25 = 3,800 pounds force

The wind would be figured as being concen- the middle of the stack and represents one a lever, and the diameter of the chimney at plus the distance out to the center of the bolt the other. In this case this distance is 5 feet pull on the bolts will be 3,800 × 32.5 half ht of the chimney, divided by 5 feet equals 32.5 ÷ 5 = 24,700 pounds. urse only half of the bolts can be available, no which way the wind is blowing. The bolts e capable of withstanding a strain of 10,000 per square inch of section. A 1-inch bolt as e will have a tensile strain of 5,500 pounds re inch. The holding strength of five 1-inch uld be 27,500 pounds. As only half of the standing the strain at one time ten bolts were for our stack. This gives sufficient holding make up for the weakening of the bolts g the threads, as only nine bolts are actually to stand the strain of the wind against the

W. A. B.

Pumps.

f the Engineers' Review:

March issue of the Review on page 23, Hugh ell says Harry C. Faber is wrong when he plex pumps give duplex troubles.

had both kinds of pumps in the same room under the same conditions and the duplex more to maintain and keep in repair, and n all kinds of trouble under good care. I ive my pumps as much care as I do my en- the duplex takes more steam, does it not e oil and have more parts to get out of order r which cost more for renewal? You will t the single pump will do just as much work cylinders as the duplex will with four. Does use boiler pressure steam full stroke? I does, as the design of the common duplex ve pump requires the carrying of the full essure throughout the whole stroke. I do he duplex is a worthless machine as a water for they have been the old and well tried most every engineer, but when I see some- ter I will go after it every time. That is y give me a single pump. The builders of of pump know their business, but cannot set of brains with each pump.

Whiskers" I wish to take a dig at you on dy stream water pushing business for I be- will stand a little digging before your safety l lift. I see you and Faber cannot agree on delivering a steady stream. I saw the trick d not very long ago. The plant was 600 feet river and the question arose which would be est and best way to supply the boilers, sink try to take the water from the river. I said river it was. We set a little Dean pump the bank and piped the steam 600 feet, with pipe laid over 4-inch tile in a water tight box, ith sawdust. The 2-inch water line was laid ne trench only below the steam line. It was to the supply tank, then reduced to 1¼ inch e tank 22 feet above the level of the pump. p gave a steady stream, not by jerks or , and stepped off 80 strokes per minute, 24 ay, six days a week. I gave this pump a call three times a day and it received one pint of oil every 24 hours. I never knew it to stop only when we stopped it, in the four years I had charge of it. I only renewed the piston packing in the water end twice. This was a single cylinder pump.

This pump question is like the wrench problem on valve wheels. I admire the way old Bill B. Banger expressed himself on the subject in the March issue. The man that designed the wheels on those valve stems did not know his business or had forgotten that it required a wrench to close them. I believe when it is necessary for an engineer to use a wrench on a valve he is standing on his own or his employer's pocket book with both feet, and squeezing it pretty hard.

H. J. A.

Believes Deception is Common.

Editor of the Engineers' Review:

I have been very much interested in reading the articles appearing in the Review on deception. While we all know that it is wrong to deceive and in the abstract we should never resort to deception, still to all questions presented there are always two sides. If every one would do their duty and be honest, there would be no such thing as deception, but mankind is frail and we are bound to fall. Ethically speaking this is a dangerous position to take, and we don't always try as we might to bring commercial transactions and engineering practices to a high ethical plane.

I was at one time trouble man for a large shop and we had a customer for an air compressor. He came to the shop and from several styles selected a cross compound affair, with a slide valve. The cutoff valve worked with a hand wheel on the high pressure cylinder. The machine was built, shipped and erected by the purchaser. In a few days we got a telegram telling us to send a man at once as the compressor would not work.

I took the first train getting there as soon as possible. On looking over the plant I found the compressor erected all right, but the trouble lay in the fact that they had it connected to a very small receiver, about 36-inches x 5-feet. The compressor being controlled by a pressure governor, as they were using very little air, about ¼ the capacity of the machine, the governor would stop the compressor and it would stand from seven to 15 minutes. The compressor nearly always stopped with the high pressure cylinder on the center. When the receiver pressure had fallen enough for the governor to work and admit steam, the steam in the low pressure cylinder had condensed so much that there had not pressure enough to start the machine. I told the purchaser that he could not get good service out of the compressor connected up like that. He contended that the connection was all right, quoting an instance of another machine of the same make, but of a different style, that would do its work and give good results.

I lost a good deal of time and patience trying to explain why it was not practical, but he would not see it. At last he told me that the compressor would have to work as it was set up or out it came. It was a difficult proposition, and I tried to think of a plan of overcoming the difficulty. There was a 1-inch pipe running from the high pressure steam chest to the low, having a globe valve in it and while every one was at dinner I took the valve disk off the stem.

When we started up, after going all over the engine and pretending to set the valves, etc., the machine worked fine. With the help of the high pressure steam in the low pressure cylinder, it would start up all right.

My company got their money and the purchaser was satisfied. Here was a case of deception which I thought justifiable. In this case the purchaser got exactly what he bought, but through ignorance he applied it to a use for which it was not built and through stupidity he could not be shown why it was not possible to make the machine do what it was not intended for. I had either to deceive this party, or have my employer go to law for his money and every one who has had a machinery case in the courts knows what that means. I suppose some of your writers would have let my people go to law and be kept out of their money maybe for years and spent twice the profit on lawyers' fees, etc., but I can't say that I lost any sleep from a sore conscience over this deception.

W. E. Van Hoose.

Another Kind of Deception.

Editor of the Engineers' Review:

The several recent accounts of bursting flywheels, recall to my mind a very narrow escape I had a few years ago while running a saw mill engine in Mississippi. The engine was of the plain slide valve type, 22x30-inch, running at 160 revolutions with an 18-foot flywheel.

I had the night run and was sitting on a bench beside a 12x12-inch post about 2 o'clock. Everything was running smoothly when suddenly without warning I heard a crash. I sprang to the throttle valve. This act saved my life, for I had scarcely left my seat, when the post I was resting my back against, and just at the height of my chest, was struck by a fragment of a pulley, weighing 19 pounds, cutting into the post more than 1¼-inch.

The ruptured pulley was a new one only having been in use about 10 weeks. It was 42 inches in diameter with a 22 face, running something over 100 revolutions a minute. At first we were all at a loss to account for the cause of its breaking, but on closer examination we soon found a flaw in the rim from one edge extending about 2-5 across its face. This flaw ran clear through the rim for half its width and half way through the remainder. It had been plugged up with soft metal and painted over to hide the defect. From that flaw a crack started which ultimately caused the wreck.

The point I wish to make is this, I have seen other castings doctored up in the same way and think that this practice should be stopped. Evidently the builders of the pulley knew that it was highly dangerous and also that it would never sell if detected, or they would not have taken the trouble they did to cover up the defect. The deceptions practised by engineers mentioned in the Review fade into insignificance when compared with such as this.

When I took charge of my present work there were three engines working. I will designate them as Nos. 1, 2 and 3. No. 1 is a 16x24-inch slide valve with a shaft governor, No. 2 is a 14x16-inch plain slide valve and No. 3 is a 11x16-inch, also a plain slide valve. I found all three in very bad shape, No. 1 es
so. After I had gotten them in fair shape, I f
almost impossible to keep up a proper head o
with the fuel at hand (yellow pine saw dus
although they did much better than before I
on them, there was something wrong somewh
decided to cut out No. 1 and 2 engine entirel
ting all the load on the large engine and th
trouble ended. Now we have more saw du
can be burned in the furnaces, and steam
off frequently every day. The large engine p
extra load more evenly and smoothly than it
lighter load before the change and the mill cut
lumber daily than it used to.

'R. E.

False Water Level.

Editor of the Engineers' Review:

I was much interested in the letter by "Old
in a late Review, in regard to his trouble with
water level in water glasses. He says that on
showed wrong because it had a hole in the ste
leading to the column. It would seem to me
the hole was large enough to affect the gauge
extent, it most certainly would have been large
to have been discovered before it could have d
damage. It would seem more probable that th
something plugging up the pipe which cau
water to stand so high in the glass.

On a 6-foot tubular boiler, we have a water
connected to the boiler by 1¼-inch pipes, brass
bottom. The water gauge is drained by a
valve. We can open this valve half a turn
water line will hold at its proper level in th
and there is no reason apparent to me why it
not, when the pipes are of ample size and kep
When we open the drain valve more, of cou
water will leave the glass. We use valves ins
cocks as they are more satisfactory in every
fail to see how a slight leak around a stuffingb
water column glass can affect the water line
states.

One night I had occasion to go to the engin
and being unable to arouse the night man,
through the office to the engine room, and fou
all doubled up and unconscious upon the boile
floor. Both boilers were under steam with a
fire under each and the glass full, the pump
and feed open on the one boiler. The water
low in the other one that it could just be ca
the lower gauge cock. The man was alone a
had not happened in just as I did it would of
have resulted in a badly burned boiler. We t
on an alarm column and as I live only a short
away from the plant we felt secure that shou
a thing occur again, we would be notified of
by the alarm column. That is the reason I t
alarm column is a good thing.

There is one thing I have noticed where a
column is used that should be prohibited, *i. e*
ling the whistle either by putting a washer un
bell of the whistle, or stuffing waste into it. A
man who cannot run his boilers without the
blowing, should be exchanged for one who ca

William S. Tro

Bill B. Banger on High and Low Water Alarms.

Editor of the Engineers' Review:

I went to church the other Sunday and heard the preacher argue the question as to whether the world was getting any better or not, until I pretty nigh went to sleep. After he had thrashed the thing out to his heart's content, he decided that it was a little bit better than it had been, taking everything into consideration. When I got home I summed the thing up, as they say in engineering talk, and about concluded that the preacher had hit the nail plumb on the head, when I happened to think I had not finished reading the Review, although I had set up the night before until 18 minutes past 12, I got so dinged taken up with it.

About the first thing I came to was the letters on the high and low water alarm, and after reading them I could almost hear the whistle blowing. By the time I had read the last one, I came to the conclusion that the preacher had made a mistake. Some of the firemen tied bags around the whistle and some tied rags around, and others just let things sing. Durned if I know which was the worst.

One of the boys happened to drop into my den the next morning and asked me if I had read the sayings of the other great writers in the Review, and I told him I had and incidentally gave my opinion as to the right or wrong of tying a whole dry goods store around a safety whistle. It wasn't mor'n half an hour before every engineer in town had heard about what I had said, and the association to which I pay my dues, sent up a gang to invite me to give a lecture on the high and low water alarm at the meeting, which was to be held the next Friday night.

After some hanging back I told them that seeing as I had begun to write for the press and as I just got my pay raised a dollar a month, that I would come prepared to spout a mite, if they would promise to throw any one out who objected to what I had to say, as I wasn't in the habit of taking any back talk from anyone.

Well, they said that the first man who dared to breathe out loud would get it in the neck, and with that understanding I told them to get the band ready and I would do the rest.

It made me a little mite shaky to think of getting up before a lot of engineers "wise and otherwise," as some one has said, and try to pump a little common sense into their heads. I had an awful time getting ready. I lost my collar buttons 15 times, if I did once, and every time, the dinged thing made a dive for the bed and in nine times out of ten it got there ahead of me. Now if any of you fellows think there is anything in fishing after collar buttons under a bed that will help to improve a man's temper, especially when he is going to give a lecture, you are away off in your reckoning and don't you forget it.

I finally got ready and meandered down to the hall where the boys had assembled to await my coming. I say I meandered, because I didn't want any one to think for a minute that I was feeling uneasy. They gave a cheer when I came into the room and some one yelled, "gee, look at his whiskers." I never turned a hair, but I walked right up to the front and after bowing to the "Chief" I began to remove my hat and coat, overcoat I mean. Then I mounted the platform and sat down.

After the chief had looked at the gang for a spell and wiped his face with a handkerchief about 23 times, he arose and after a good deal of shuffling of the feet, said, "There ain't any use of taking up the time that ought to belong to Mr. Banger, who is to speak to us tonight. You fellows all know Bill, and he knows the most of you, which ain't, as I know of, any great thing to brag about, Bill's knowing you, I mean. He's going to tell us something about high and low water alarms. It ain't because none of you have any on your boilers, but because not mor'n half of you know whether you have got them or not. I want to say that the first one of you fellows that says anything against what Bill says, get thrown out, sin or die, as the mayor says when he lets the boodle aldermen go home after a meeting. There is no use in wasting any more time in an introduction. Now go ahead, Bill, and tell us all you know. We'll give you half an hour."

I didn't know just how to take that last remark, but I put it down to the chief being a little uneasy on account of my setting up along side of him, so I leisurely got up and walked to the front of the platform and after bowing to the chief and then to the gang I said, "This is one of the happiest moments of my life, and it gives me more pleasure to stand up here before this crowd than anything I have had since I had the grippe. I will allow that I was a little mite shaky before I came here, due to a cold, but I feel considerably better than I did, since I have heard the remarks of our honorable chief.

ALL THE THINGS I HAVE HEARD OR READ OF AGAINST THE SAFETY ALARM DON'T AMOUNT TO AS MUCH AS A ROW OF FODDER CORN.

"We haven't got time to go into the history of high and low water alarms, and furthermore it ain't necessary. The main thing is to know what they are for. Now the burden of my remarks are based on a few points brought up by some one in the Engineers' Review, which the most of you either subscribe for, borrow or steal.

"Now the whole thing is right in a nut shell, and is as plain as a smoky chimney. The high water alarm is to tell a fireman that his water is too high for comfort, if the engine is to be considered; but I want to tell you one thing, you don't hear that whistle blowing if the fireman is worth a tinker. The low water alarm is to tell the fireman that his water is too low for comfort, if he don't want to go sailing up in the air. A fireman who will let his low water alarm blow many times in my plant goes looking for a job.

"The question of the high and low water alarm is just another case of where some of you Jays are content to believe in the old adage, 'Where ignorance is bliss, 'tis folly to be wise.' These alarms are O. K., A. No. 1, E. Pluribus Unum, and I will swear by them day and night and in vacation time.

"This whole argument started from what a professor of one of our colleges said, who got on his ear and is going to ask the legislature to repeal the law which says the safety columns have got to be put on steam boilers. It's a pretty sure thing, fellow sufferers, that the professor never spent very much time in the fire room in front of boilers, and I calculate he could tell you the different kind of bark on trees and petals of flowers a ding sight easier than he could keep up steam on an overloaded boiler. (Applause.)

"Fellows, there is one thing I want to say," and I lifted my voice loud enough to be heard down to the foundry which was half a mile away, "All the things I have heard or read of against the safety alarm, don't amount to as much as a row of fodder corn. Of course you fellows can believe just what you want to, but I don't want to hear any dissenting voice while I hold the platform.

"If any of you are chumps enough to build a roaring fire under your boilers, then go to some part of the shop and loaf around until it's time to go home to dinner, you would do it just the same whether you had an alarm on your water column or not.

"Gentlemen," and I shouted as I began to wax eloquent, "as we view this gigantic question, looking back into the invisible past, as we dig down into our text books of science and other things, nowhere do we find a dissenting voice raised in objection to the use of the subjects which we are discussing this evening, except from those who are busy thinking how they can get along somehow or other without doing any work.

"The most of you fellows are like the minister who divided his sermon in two parts; he talked about all the things in the text and all the things not in the text, but he wrestled with the things not in the text first, and that's what you fellows are doing with the high and low water alarm. (Applause.) Gentlemen, in the name of the immortal John Smith, you don't need to be a philosopher to draw deductions and learn lessons from the misfortunes of others.

"One of the prominent writers of the day has said that the tendency of the safety water columns is to increase the duties of engineers and firemen. 'Tis true, all too true. We know it as we bend our backs beneath the blistering rays of the July sun as it streaks in through the cracks in the roof of the fire room. We have realized it when the boss came and told us to repair a pipe or grease a bearing or throw on a belt for some lunkhead who was too lazy to do it himself. And this about three minutes after we have got the blind staggers from cleaning fires, but gentlemen, don't forget that this same condition of affairs is a matter of historical interest and was practiced before you and I were born. (Applause.)

"What the engineer wants today is a chance to show
what he can do. That's the reason I get on s
If you can get your firm to get you a high a
water alarm, get it. It won't do you any har
judging from the looks of the gang here ton
should imagine it would save a few dollars
course of a year or so in boiler repairs."

Somehow or other this didn't seem to strike
sponsive chord in the ears of my hearers and
marks echoed around the room as the stillness s
to deepen. Continuing, I said, "Don't be afraid
automatic devices in your plant, kick for them
for them, holler for them, anything to get the
when you've got them let them do the work th
supposed to do.

"Another thing, don't go outside your engi
fireroom and help every loafer around the sh
his work; keep in your own place and do wh
are paid for and strain every ounce of streng
have got and see that you get paid for what y
It's just as important for a man to try to se
much he can get out of the boss in the shap
weekly pay or salary, whichever you want to
as it is to see how many tons of coal he can sho
a furnace in 10 hours. The more you get of o
better, and the less you do of the other the bette
you will be to enjoy good old age. (Applause.

With these remarks I sat down. I fished
handkerchief, but it was gone, my collar w
wilted down on both sides, but I felt that I ha
my duty to my fellow men. Bill B. Ban

Good News For Bill.

Editor of the Engineers' Review:

Although having been a practical running en
for the past 28 years, I find many very good s
tions and useful kinks in reading the Review, a
til I reach that most foolish age when a man
he knows it all, I expect to continue reading t
view and other good works.

I wish to say that the story of our friend "
Banger," in the February issue, was the me
securing a good raise in pay for an enginee
placed a copy of the Review upon his employer'
with Bill's story open before him, and no furth
or remarks were necessary to put this one em
next to the fact that he had long neglected his
ciation of his engineer's care of the boilers. Flu

Determining the Positive Wire—Cutting out mos, and Double Eccentric Engines.

Editor of the Engineers' Review:

The following little scheme that may be us
testing a line in order to determine which is th
tive and negative wire. This is done by using
mon blotter saturated with a weak solution
phuric acid or any kind of acid which is an ele
conductor. The blotter should be placed upon
surface and the wire stretched upon it about 2
apart. It will be found that the positive wi
leave a mark while the other will not.

The reason for this is that the two wires in co
ing with the liquid in the blotting paper, form a
plating tank and the copper on one end of the
dissolved and combines with the acid forming
tallic salt. For instance if sulphuric acid is u

ting paper, the copper combines with it, and
sulphate of copper, or as more commonly
lue vitriol. This is an easy way of determining
tive and negative wire and is at the same time
xpensive.

e noticed in several questions recently that
the boys apparently do not understand cut-
of circuit, one or more dynamos running in
being in doubt whether it is better to first cut
resistance on the machine and then open the
itch, or some other way. The way we cut out
amos, which are shunt wound running in
is by adjusting the field strength of the two
s so that the one remaining in circuit takes
ll of the load before opening the main switch
ther machine. We make the transfer of load
asing the strength of the field of the dynamo
t out by cutting in resistance, when the load
sfer to the other machine.

er method that can be used to get the same
by increasing the strength of the field of the
which is to remain in operation, by cutting
stance in the field, when the greater part of
will be transferred to that machine. It is un-
wever, to transfer too much load, especially
ler plants where one ammeter is made to do
two machines, because the operator is unable
exactly how much load is on each machine.
mmeters are provided for each machine, how-
e load may be thrown to the machine which
ain in operation until the other, which is being
is carrying only a few amperes, when the
itch may be opened without causing a flicker
ights.

r plant we have a Corliss engine, having two
s. Some of the boys are not familiar with
e and cannot understand why the cutoff can
late as ¾ stroke. Thinking perhaps some
eaders of the Review do not understand the
, I am giving my ideas as to why this is
A Corliss valve can be tripped and closed
ring the period that it is open. As long as
ntric is moving in the direction to pull the
en, the governor action can trip the valve.
he eccentric has passed its point of greatest
nd begins to close the valve, the governor is
r controlling the valve and cannot trip it un-
ext stroke. When one eccentric only is used
be located more than 90 degrees ahead of the
order to open and close the exhaust valves
. By the time the eccentric has reached its
throw and has begun to move back in the op-
lirection, the crank has reached about half
which is practically the latest point at which
an occur through the action of the governor.
two eccentrics are employed, one of them is
te the steam valves and the other the exhaust.
aust eccentric is set the same as the eccentric
ingle engine, while the steam eccentric is set
ery short distance ahead of the crank, or just
to cause the steam valves to open an equal
on the lead when the engine is on the center.
r to place the eccentric in this position the
ust have less lap than in the case of the single
engine, or say about a quarter of an inch,
gh to make them tight.
a steam eccentric in this position it will not
position of extreme throw until the crank has reached about ¾ stroke and the cutoff by the governor can occur up to this point. It is possible even to delay the point of cutoff to ⅞ stroke, so it will be seen that the operation of the double eccentric is far more simple than most engineers who are not familiar with them think.

F. S. K.

Definite Information Wanted.

Editor of the Engineers' Review:

In your issue of March, I observe a letter from brother Harry C. Taber, in reply to "Whiskers," giving his rather remarkable experience with different kinds of pumps. I am interested in the general welfare of the cause, to the extent that I would like to know where the pump he mentions is made, what it looks like and where I can get one.

I have had most all of the pump troubles that are possible and if I can get relief, it is what I want. Will Mr. Taber kindly favor me with more definite information in your columns in regard to the matter?

M. M. Foster.

Compressor Diagrams.

Editor of the Engineers' Review:

I was much interested in Mr. Price's analysis of the air compressor diagrams, shown in the January Review, and I will assure him that they were genuine, and were made under the conditions stated, with a Crosby indicator. Diagrams taken with a Fabor or a Thompson indicator are the same, so I don't think the trouble is in the indicator.

I don't pretend to be an expert on indicator diagrams, and those needle points puzzled me. I have never had an explanation that was satisfactory so I sent them to the Review, hoping that some one would throw some light on the subject.

Those needle points can be placed on the diagrams by simply speeding up the compressor. This was the only change made, when diagrams No. 2 and No. 3 were taken, except that the air pressure was higher on No. 3. I did not think much data necessary, as the only question under consideration was the needle points. I am not running the compressor now, but will give as much data as I can remember. The diagrams were taken with a No. 60 spring. The diameter of the cylinder is 11 inches, and the stroke 16 inches. The speed when diagram No. 2 was taken was 70 revolutions a minute. No. 3 was taken at 130 revolutions a minute. I do not know the clearance volume. The compressor has ordinary poppet valves and coil springs to seat them.

As for delivering too much air, would not leaky discharge valves produce the needle effect, and would not both diagrams be alike, if the clearance volume was equally divided? This can be done by screwing the piston in or out of the crosshead. I notice that diagram No. 2 is 1 inch high, as Mr. Price says, but I don't think they are reproduced full size. I am sure the indicator drum was revolving the right way at the right time.

Jack.

An Engineer at Home.

Editor of the Engineers' Review:

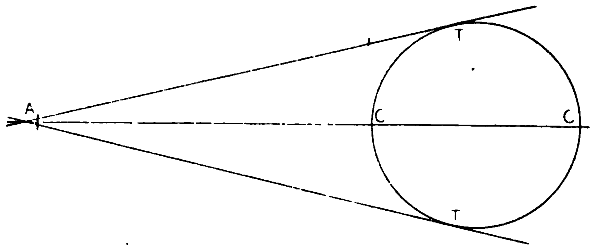
In looking over the Review, I notice many letters from engineers and some from their sons, but no letters from engineers' daughters. "Pop" is an engineer, and although a great reader he dislikes writing so I perform the duties of secretary for him.

Last evening Mr. Taylor called at our house, and after a friendly greeting said, "Pop, I have been trying for the last three days to come over to your engine room, but have been very busy, so if you don't mind talking engines—"

"Engines," said I, "he would rather talk engines than eat."

"I take the Review," said Mr. Taylor, "And find a good many helpful things in it as well as questions asked and answered by the readers. Now I have one for you. About a week ago I had some new governor pins made and after putting them in, the valves had to be set. I set them with the same lead and compression they had before, but there was a pound in one end. When I gave the head end a little more compression, the pound stopped. Now did I do right?"

When "Pop" replied, he said "I do not subscribe for the Review, but the firm does and sends it out to me every month, often with marked articles, and I guess they think it pays them. Although I have been working at the business for—well from boyhood to, baldness, I will acknowledge that I did not know how to repack an asbestos-packed cock until I learned it from the letter by C. B. Risley published a while ago. That little article in the Review just saved the firm exactly $12, as I had two of those cocks ready for the scrap pile, which are now as good as new. But about the compression question.



SHOWING THAT THE SPEED OF A PISTON DIFFERS AT DIFFERENT POINTS OF ITS STROKE.

"Now, at what point of the stroke does your piston travel the fastest?"

"Why, I don't know exactly," said Mr. Taylor, "but I suppose when the engine is on the quarter."

"Now, here I will show you," said "Pop," as he grabbed a pencil and paper. "Take the point *A* for the crosshead pin and *C* for the crank circle. *T T*, are the tangent points or the only places on the circle where the piston and crankpin travel near the same speed, as at these points it is a direct rush and pull. You will readily see that the distance from the center on the head end to the tangent points, is only a little over 1-3 of the crank circle. Therefore on the head end you have only a little over 1-3 of the time it takes the crank to make a revolution in which to bring the piston from a stop to its fastest point of travel, and on the return stroke the same time to bring it from its fastest speed to rest at the head end again; whereas on the crank end you have a much longer time to get from the highest speed to a stop and the same time from a stop to the fastest point of piston travel. That is why you need a little more compression and a little more lead on the head end than on the crank er horizontal engine."

"I see," said Mr. Taylor, "But why do you sa izontal engine?"

"Because" said Pop, "on a vertical engine the of the piston rods and crosshead just about ov this difference in speed, and so I have made a p to set the valves even on vertical engines.

Pop's Secreta

Is Firing Necessary to Success?

Editor of the Engineers' Review:

The letters by E. T. C. and Slim Jim have b up a subject which is of more or less interest gineers and which will doubtless be commen somewhat. I am satisfied that a man can n better success as an engineer by having a kno of firing, than he could if that knowledge was l Too many engineers get a notion that the ne qualifications of a fireman is plenty of musc endurance, all that is necessary being that h be able to shovel in all the coal the furnaces ca sume, losing sight of the fact that a fireman use his head as well as men in other occupations

It is more than evident that an engineer w been through the mill as a fireman and thor understands that part of the business, will be fitted to superintend the fire room crew, than knew nothing about it. He would also be detect losses due from different causes, of whic are many, and would have every chance of ma better showing than the engineer who knew about it whatever, but depended upon a firen see that the highest economy is carried out in room.

I don't think Slim Jim makes a good poin he states that he cannot see how T. E. C. is g keep his engines going for although he may the principles of firing until he is gray head can't step down into the boiler room and force unless he has had experience. It appears to when an engineer gets a position as chief e in a plant of sufficient size to have firemen it d devolve upon him to step down into the firero force the boilers. The firemen are supposed to and not the engineer. He goes on further that if a fireman don't know how to fire with e and keep the fires in proper shape to hold ste doesn't see how the engineer is going to show he doesn't know how himself. Supposing t gineer did not know how to fire properly, it is that all the firemen on the shift would not b perienced men and the probabilities are that perienced men would instruct the firemen wh not, without the aid of the engineer. In fact en in the average steam plant where firemen are re do not spend their time in the fireroom inst men how to do their work.

I agree with Slim Jim when he says he don' there are many machinists who make success gineers. I think that the reason for this is t cause machinists do not take up the work very but I see no reason why, if a machinist shou a notion to start engineering he would not make cess of it. He would certainly have the advan knowing how to handle tools and how to do mec which is more than a good many engineers o.

hear considerable said regarding the time it a machinist to do a certain amount of work, but know that while they may be slow in some par- rs, as a rule they are accurate and do their work ıechanical way. It is doubtful if we would find putting a Stillson wrench on the polished nut of a cylinder or steam chest or any other pol- part of an engine. I do not believe that the :er who tries to do his own repairing necessarily :ts something else, at least that does not occur ' plant and I have done considerable repairing ' time. When it is a large plant, the engineer not to be required to do his own repairing. ıs other things to take up his time. He is the intendent of that department, and is the one to at alterations and repairs are carried out as they l be. In the smaller plants, however, the en- : does not have such cares and duties and there reason why he should neglect any part of his if he attempts to make his own repairs when ıre within reasonable bounds and of such a na- hat he can do it as well as another man if he has)ility.

Mij Mils.

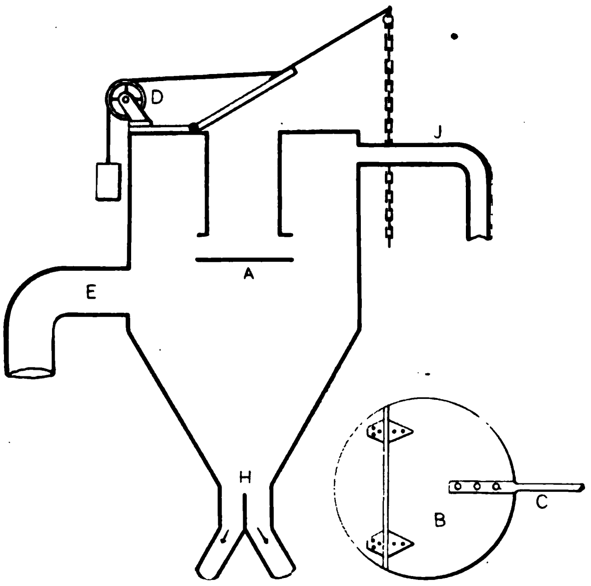
Trouble With Sawdust and Shavings.

r of the Engineers' Review:

ihort time ago, a well known firm in the lumber :ss installed a shaving collecting system to enable to collect and burn all of the refuse shavings and ıst as fuel under their boilers. The refuse was ted by means of a 55-inch fan and delivered to the furnaces, being carried through a col- or separator which was supposed to act as fol- The shavings or other refuse are blown into parating chamber, the heaviest part of the ma- being carried by centrifugal force and gravi- against the lower portion of the separator and .rged through pipes into a vault or other re- le. The fine or lighter part of the material such st, etc., rises to the upper part of the collector discharged through a separate pipe to the bins ılts designated for the same.

er the apparatus was installed it was found that stem worked with light shavings, but when wet ıvy shavings were blown through the pipe it im- tely became clogged up, which entailed a good f labor in cleaning it out. On the other hand, if wind pressure was added when light shavings being made, the pressure was too great and most : shavings were blown over the bridgewall and ıp the combustion chamber, which made still more cleaning that out, and was also the means of ıg out several blowoff pipes. The wind pressure egulated by having a flat disc *A* inside of the ıg collector as shown in the illustration, which ltered by cutting off or adding to the said disc ıs deemed necessary. This arrangement was t as far as it went, but when the plant was run- was found to be impossible to alter the wind ıre and as different kinds of shavings were being all the time while running, the system was blowing shavings over the bridgewall or the were clogged up. In the illustration the pipe *E* o the machines, while the lower pipes ran to the overflow vault and furnace, the shavings being regulated by the damper *H*. *J* is the dust discharge.

The firm that installed the system was communicated with, the idea being to arrange some kind of a regulating device. After an inspection it was found that this would entail a large additional expense, so it was abandoned with the result that for a time the system was not in working order. After fooling around with it for a time, the handy man of the plant concluded to experiment a little himself as it did not seem possible to make it any worse. Some ⅞-inch match lumber was procured and a lid made the same size as the top of collector and cut through as shown at *B*. The small part was bolted down to the top of the collector. A pair of good heavy strap hinges were procured and screwed onto the lid as shown, and *C*, a rod of iron was bolted across the top of the cover and extended about 2 feet on the outside as shown. A chain was then run down and connected to a large grooved pulley in the fire room. This gave the fireman control of the amount of wind used, but they found that after the cover was pulled down it would not go back when released, so a small grooved pulley was placed at the back of the cover and a chain carried over it with a weight on the lower end as shown at *D*. After this was done any pressure of wind desired could be obtained. If heavy material was coming down the pipes more wind pressure could be added by pulling down the cover and if light material, the pressure could be reduced by releasing the cover thereby doing away with the nuisance of blowing over the bridgewall and filling up the combustion chamber. When they got the rig in operation it worked to perfection in the fireroom, but they run up against a snag at the blower for if the fireman pulled the cover down too close it made a back pressure on the fan which consumed more power in running, and also made it difficult to draw the refuse from the machines, but by using the rig carefully they made it work very satisfactorily. The rig did not cost over $3. and has been in use over a year, during which time they have not had the pipes clog up, nor have they had any trouble with burnt blowoff pipes.



METHOD OF REGULATING THE AIR PRESSURE.

Eccentric.

Engineers' Review

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INSPECTION.

Judging by the reports, published in the daily papers, of accidents and loss of life resulting from the failure of some piece of apparatus in the mechanical line, one is forced to the conclusion that the inspector is a much overworked man or that he is criminally neglectful.

We do not refer to any particular inspector in this
instance, but all inspectors, building, boiler, ele
and others appointed by state or municipal go
ments, seem to be either overworked or afflicted
the microbe of laziness. Even the inspector
pointed by insurance companies are not any too
ful. We know of many cases where the insp
have found defects in apparatus and brought it
attention of the owners, but however, did not
upon having the defect remedied at once. The n
was allowed to run along for months until the bu
collapsed, the cable broke or the boiler explode

The result is a tragedy, several persons losing
lives, usually. This is followed by a comedy, in
each of the responsible parties tries to shoulde
blame off on to some other party. Just as we g
terested in the discussion something more ex
arises and we forget all about the case until the
accident occurs.

Now this is all wrong and we all know it.

If it is necessary to have boilers inspected at
is just as necessary to have competent inspector
enough of them. This applies to all similar ca
well. Just as long as the appointment of these
is in the hands of officials elected by the peopl
people are responsible for the accidents. If we
incompetent officials we must expect the appoin
of incompetent inspectors.

Inspectors of all kinds, irrespective of their c
should come under the civil service law.

STEAM PLANT PIPING.

Engineers who are keeping well informed rega
steam plant practice in recent years, are awar
considerable care and attention is being paid t
piping system between engines and boilers. The
ency of late years has been to abolish an absolut
plication in the steam piping systems. Shut
caused by piping troubles have resulted in me
being adopted which have effected an improvem
that part of the power plant.

In eliminating the duplicate system of pipin
other system of course took its place. Some of the
modern power plants are divided into units, eac
gine being directly connected with and adjace
the boilers that are to supply it with steam. A
same time it is possible to supply any engine
steam from any boiler in the plant. This is do
using one large header to which all of the boile
connected. Under ordinary conditions however,
unit operates independently of the others. An
tration of this is shown in the plant of the Boston
son Co., which was described in the June issue
Engineer's Review. The advantage of this syste
be readily seen for should the boilers in unit
be disabled they can be shut off by closing the
valves between them and the header and stean
be taken from other boilers by merely openin
valves in the header between the engine an
boilers that are to supply the steam.

One particular feature in steam pipe practice
is receiving more attention than formerly is th
drainage. The best practice seems to be that of
pipes of from 1¼ to 1½ inches for steam h
drains. These pipes are connected to steam tra
other means, so that the system is constantly dr
of water.

QUESTIONS
·OF THE HOUR·

**is department questions concerning steam engineering of practi-
re and of a general interest will be answered.
name and address of the writer must accompany questions, but
sarily for publication. We must know the source of the question.**

3) J. A. P., Sweetwater, Tenn. Q.—"We have
48-inch Corliss engine having a steam pipe 4½
in diameter. We wish to carry the steam 1,000
What size pipe should be used, and what would
loss in condensation and friction, if the steam
re is 120 pounds per square inch?" A.—A pipe
zes larger would be large enough. It should
oward the engine and be provided with a separa-
close to the engine as is convenient. According
s with bare steam pipes the radiation losses are
3.336 to 3.81 British thermal units, per square
surface per Fahrenheit degree in difference of
rature between the steam and the surrounding
The amount of resulting condensation depends
the steam pressure. By taking the temperature
ponding to the steam pressure from the steam
the temperature of the air may be deducted to
he difference in temperature, which multiplied
radiation losses will give the heat units lost per
foot per hour. Taking an average from the
above we get a loss of 3.208 B. T. U. per
foot of surface. The latent heat per pound of
at the ordinary working pressure is then divided
rate of radiation to give the rate of condensation
iare foot of pipe per hour. Steam at 120 pounds
re gage equals 120 + 1.47 or 135 absolute, taking
vhole numbers, and the temperature of the sur-
ng air is, say 60 degrees F. The steam tempera-
135 pounds pressure absolute is 350.1 degrees F.
— 60 = 290.1. Then 290.1 × 3.208 = 930.64,
e of radiation per square foot per hour in B. T.
he latent heat per pound of steam at 135 pounds
te, is 867.59 B. T. U. Therefore 930.64 ÷
= 1.07 pounds which will be the rate of con-
ion of steam per square foot of pipe per hour.
pipe is properly covered as it should be, the
t of condensation will be greatly lessened. The
n losses in a pipe depend upon the length of the
nd the number of bends and valves in it.

9) L. L. S., Richwood, Ohio. Q.—"In an in-
n coil made for an automobile, I find a bunch of
l. What is it for?" A.—The tin-foil is what
wn as a condenser. It is for the purpose of
ting the sparks from leaping across from the
pter to the adjusting screw, when the primary
is broken. When this occurs an extra amount
rent is self induced in the primary coil. The use
condenser is to prevent sparking and also per-
f an abrupt break in the primary coil.

0) Same. Q.—"How are the wires of an in-
n coil connected and how are the wires connected
coils?" A.—An induction coil consists of two
a primary and secondary, wound around a core
of a bundle of iron wires. The secondary wind-
nsists of a large number of fine wires, while the
y winding consists of a few turns of thick wire. The primary wires are connected to insulated electrodes. The primary coil is connected to the interrupter at one end and the binding post containing the adjusting screw at the other. A battery is connected in the primary circuit to furnish the current.

(441) S. E. S., Wiggins, Miss., Q.—"I have charge of a 150-kilowatt lighting plant. The engine has a 16 x 20-inch cylinder and is governed by a Gardner spring governor, which seems to have no control over the engine at full load. The engine races for a few minutes and will then slow down to about half speed. I can find nothing wrong with the governor, but by using weights against the spiral spring, I get good results. What do you think is the trouble?" A.—You do not give enough information for a definite answer. If your generator is being worked to its full load the engine is not large enough for the work. A 150-kilowatt machine is equal to 150 x 1,000 ÷ 746 = 201 horsepower, the output of the machine not counting losses, etc. A 16 x 20-inch engine has a standard rating of about 125 horsepower, running at a speed of 175 revolutions per minute and figuring a mean effective pressure of 35 pounds, which would correspond under ordinary conditions to 95 or 100 pounds boiler pressure. Under such conditions it is not surprising that you do not get good results. We do not know what you mean by using weights against the spiral springs, and cannot see where weights can be used to advantage. We would advise you to take up the matter with the Gardner Governor Co., Quincy, Ill., who will be glad to do what they can to remedy the trouble.

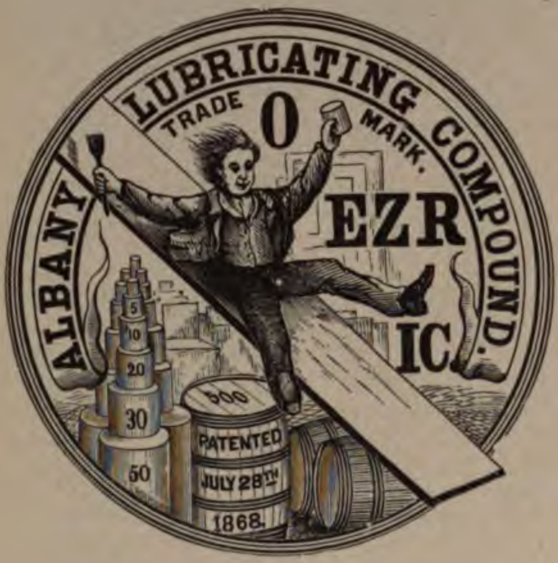
(442) M. E. W., Rose Hill, N. Y.—Q.—"I have a Snow duplex boiler feed pump, which has always worked well until recently when it failed to discharge any water to the boiler although it will discharge elsewhere. I have examined the pump, replaced the packing and looked over the valves, but can find nothing wrong. I have also taken down the discharge pipe between the boiler and the pump, but can find nothing the matter, and am at a loss as to where the trouble lies. Can you give me any light?" A.—If there is nothing wrong with the pump the trouble must be in the connections between the pump and the boiler, as you say the pump will throw water anywhere else. We would advise that the tubing in the heater be given an examination and test to ascertain whether it is free from obstructions or not. Are you sure that the check valve or the globe valve in the feed pipe line is not causing the trouble, due to the disk working loose and partly obstructing the passage of the water? If the feedpipe in the boiler extends to the rear end and is drilled with small holes as is often the case, it is very likely that the small holes have become filled up with deposits of some nature, and so prevents the flow of the water. The above causes have been found to be the root of such troubles before. The valve seats of the pump may have become loose, or there may be a passage for the water from one water cylinder to the other due to a flaw. A careful examination will expose the trouble.

To find the cubic inches in a ball, multiply the cube of the diameter by .5236.

THE ALBANY GREASE TRADE MARK.

The value of a trade mark depends largely upon its character and the quality of the goods back of it. As some one has already said, "the trade mark forms a link between the manufacturer and the consumer, guaranteeing to the consumer that the goods bearing such mark are made by the same manufacturer as the goods which he previously purchased under the same mark." The trade mark is therefore, a guarantee of quality.

The Albany grease trade mark was first used in 1868. The figure of a boy sliding down a plank which is the prominent feature of this trade mark, should be studied in connection with the letters "O-EZR-IC," which have been the cause of much speculation. Their meaning is, however, decidedly simple and to the point, signifying "Nothing easier I see" than to slide down the plank smoothly and without friction when Albany lubricating compound is applied. This applies to machinery of every description.



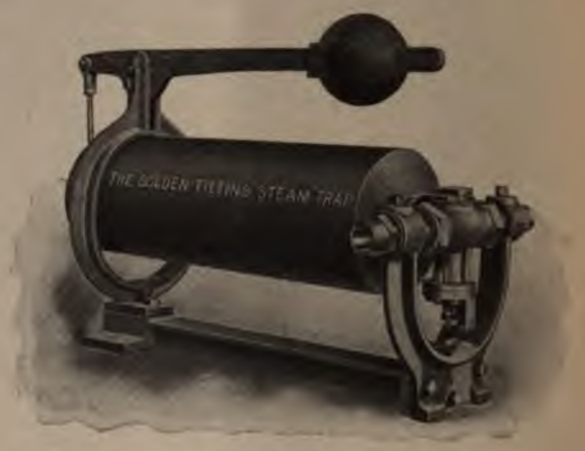
ALBANY GREASE TRADE MARK.

The letter "O," which in the trade mark represents the word "nothing," should not be confused with the numbers or consistencies of Albany grease, as published in the circular relating to Albany grease. There are seven numbers or grades of grease running from O to No. 3 and X to XXX, number O being the softest consistency in which the grease is made, and XXX the hardest. The use of various grades depends upon the climate in which the grease is to be used and the work it is to do. The result in every case, is said to be extremely satisfactory.

To prove all they claim, Messrs. Adam Cook's Sons will send a suitable Albany grease cup with a sample of Albany grease to test, free of charge or expense. You can address them at 313 West street, New York.

THE GOLDEN TILTING STEAM TRAP.

In the illustration is shown the Golden tilting steam trap which is made for both high and low pressures. It is claimed that this trap is the best on the market, because it is positive at all times and cannot get out of order. It has full area through the discharge valve, and discharges promptly, with speed, and is practically noiseless. The working parts are all of bronze and are removable. It has no floats; no valves inside of the trap, and all working parts are on the outside. This trap is made by the Golden-Anderson Valve Specialty Co., 200 Pike street, Pittsburg, Pa. They are also the sole manufacturers of the Anderson combination non-return valves, of which there are three types as fully illustrated in their booklet; the Anderson pressure reducing valve, the Anderson altitude valve which is for maintaining uniform heights of water in tanks and reservoirs; the Anderson balanced roller lock cock, the Anderson float valve, and the Anderson automatic valve and water column for railroad service. These specialties are coming into general favor because of their many merits.



THE GOLDEN TILTING STEAM TRAP.

REEVES VERTICAL CROSS COMPOUND ENGINE TEST.

The following is the result of a test made by Prof. R. C. Carpenter, assisted by Prof. H. Diederichs at Sibley college, Cornell University, Utica, N. Y., during the year of 1904-5. Fig. 1 shows a Reeves vertical cross compound engine.

Steam is admitted to the high pressure cylinder by a piston valve, which takes steam from the inside edge. The valve is controlled by a Rites shaft governor. The steam exhausted from the high-pressure, is admitted to the low-pressure cylinder, by two piston valves of identical design, operated by an eccentric from the engine shaft.

There is no receiver and the steam from one end of the high pressure cylinder enters the same end of the low pressure cylinder.

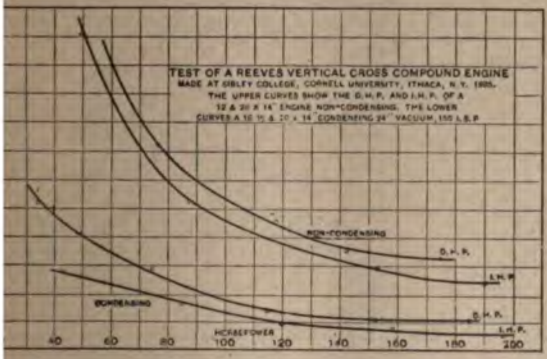
The bearings are lubricated by a simple oiling system, all oil pipes leading from a tank are placed at the f the cylinder, so that the lubrication can be ed from one point after the oilers are once set. arrangement and method of the test was as fol- The engine was connected to two Babcock and x boilers, by about 25 feet of 4-inch pipe. This was one size smaller than required, but was the t that could be obtained. In order to minimize

1. REEVES VERTICAL CROSS COMPOUND ENGINE.

fect that the resulting high steam velocity would a piece of steam pipe about 30 inches long was osed, just ahead of the throttle valve, to act as of reservoir. About 20 feet of 7-inch pipe con- the engine to a Wheeler surface condenser.

arpenter throttling calorimeter was placed be- the throttle valve, to determine the quality of The steam pressure was determined by a gage ted next to the calorimeter.

Thompson indicator was connected to each cyl- taking cards from each end by means of a three- ock.



G. 2. CURVE SHEET OF STEAM CONSUMPTION.

condensed steam was pumped by the air pump tely into two tanks on scales, and readings of sed steam weight were taken every five or ten s, as the load demanded.

the purpose of test the engine was fitted with eel, 5 feet in diameter on the low-pressure side. this wheel was placed the prony brake to determine the horsepower developed. The brake was in all respects of the ordinary standard design. The wheel was kept as cool as possible by running cold water constantly onto the flange rim. By these arrangements, as much as 185 developed horsepower was taken from the one brake.

For the condensing series as high a vacuum as could be obtained was carried, which averaged about 24 inches; for the noncondensing series the air cock on the condenser was kept open, insuring condensation under atmospheric pressure. For the condensing runs the dimensions were 10½ and 20 x 14 inches. For the noncondensing runs, 12 and 20 x 14 inches. This change was effected by taking out a liner from the high pressure cylinder. These dimensions make the cylinder ratio in the first case 3.60, and the second, 2.75.

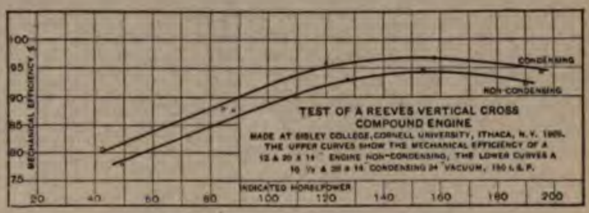


FIG. 3. CURVE SHEET OF MECHANICAL EFFICIENCY.

The steam consumption per indicated horsepower and per developed horsepower for various loads and steam pressure is computed on the basis of dry steam.

For the purpose of facilitating inspection of results and discussion, the water rate and mechanical efficiency are plotted on the curve sheets, Figs. 2 and 3.

Two things are to be noted about these curves, the cutoff even at the high load does not seem to be late enough to cause any marked rise in the steam consumption at overloads. In fact at most cases little or no rise could be determined. Again, the curve shows good economy over a wide range of loads.

The mechanical efficiency curves, show a steady increase with a load at any given steam pressure. On the overloads the efficiency falls off, but slightly.

OHIO STATE CONVENTION NOTES.

At the booth of the Lagonda Mfg. Co., Springfield, O., engineers could find a remedy for trouble with boiler scale. The display consisted of Weinland tube cleaners, Lagonda tube cutters, also Lagonda damper regulators and valve reseating machines. H. F. Weinland and Robt. Gregory represented the company. Celluloid rules were handed out as souvenirs.

The Lunkeheimer Co., of Cincinnati, showed a complete line of their oil cups, lubricators and other specialties. The W. M. Pattison Supply Co., of Cleveland, represented them. The Wm. M. Pattison Supply Co. were represented by H. Brainard, C. McComes and E. W. Jones. Among their exhibits were the well known Reliance safety water columns, steam engines, boilers, pumps and engineering tools. The Reeves Rubber Co., of Boston, Mass., also occupied a portion of the booth and was represented by W. D. Rigdon. This booth was one of the most attractive in the hall.

The V. D. Anderson Co., of Cleveland, were represented by H. H. Van Dersee, who explained the construction of the non-collapsible copper floats used in Anderson steam traps in an interesting manner.

The Strong, Carlisle & Hammond Co., of Cleveland, were represented by L. P. Strong. This company represent Greene, Tweed & Co. of New York; Quaker City Rubber Co. of Philadelphia and others.

The representative of Greene, Tweed & Co., B. W. Ham, had a fine display of Palmetto rod packing, also P. P. P. rod packing and [illegible] sheet packing manufactured by the Quaker City Rubber Co.

The [illegible]-Hughes Co., Cleveland, O., exhibited their [illegible] duplex pump in which the valve gear is protected from dirt, dust and the man with the monkey wrench. This pump was fully described in a recent issue of the Review. H. M. and C. A. [illegible] represented the Company.

John A. Roebling's Sons Co. exhibit a variety of wire rope, cable and insulated conductors, etc. Their souvenirs were books containing information regarding the Brooklyn Bridge, which is most interesting, also a little red book, containing tables and valuable data relating to wire ropes and cables. A neat little souvenir which would have been a winner, had not the representatives been disappointed, was that of a watch charm made of endless German silver wire. Several thousand were expected, but did not arrive in time. Engineers wishing one may procure one by writing W. P. Bowman, manager, of the Cleveland branch.

The Allis-Chalmers-Bullock Co., represented by E. H. Monosmith, were distributing bulletins illustrating and describing the latest type of motors and generators.

NEW BOOKS AND CATALOGS.

"BOILER ROOM CHART."—Published by Norman W. Henley Publishing Co., 136 Nassau street, New York. 14 x 28, price 25 cents. This is an educational chart, showing in isometric perspective the mechanisms belonging in a modern boiler room. The various parts of the appliances are shown broken or removed, so that the internal construction is fully illustrated. The chart, therefore, serves as a dictionary of the boiler room, the names of more than 200 parts being given on the list.

"MODERN ELECTRICAL CONSTRUCTION," by Henry C. Horstmann and Victor H. Tousley, Frederick J. Drake & Co., Chicago, 1905. 243 pages, 138 illustrations, 4 x 6½, leather. This volume is intended to be a reliable guide to the beginner in electrical construction work, and tells him exactly how to perform his work in accordance with the latest approved methods. The book is also made valuable in that it gives safety rules of the "National Electric Code" of the National Board of Fire Underwriters which have been given in full and used as a text in connection with which there are interspersed in the proper place a complete explanation of such work as the rules may apply to. This book is valuable to the electrical worker, as it is necessary for him to at all times keep posted. The book also contains tables concerning screws, nails, number of wires that can be used in a conduit, etc., which have been prepared especially for this volume.

"PRACTICAL PERSPECTIVE," by Frank Richards and Fred H. Colvin, the Derry Collard Co., 256-257 Broadway, New York, 50 pages, 5½ x 8, 62 illustrations. 1905. Price, 50 cents, or $1 for a copy of the book and two pads of the paper. The first part of the book makes clear the principles of isometric perspective, which is the only practical perspective for mechanical work. The second part shows its application to some of the kinds of work for which it is adapted. These examples include architectural details, lathe work, jigs and fixtures, pattern work, locomotive details, structural steel work, concrete piping, blacksmithing and carpentry. Its object is to show the practical value of isometric perspective by removing the difficulties that have prevented its wider use. This volume should be of great value to those interested in either mechanical or freehand drawing.

THE TABOR INDICATOR is interestingly described and illustrated in a handsome catalog recently issued by the manufacturers, the Ashcroft Mfg. Co., 85-87-89 Liberty street, New York. The Tabor indicator is made with either outside or inside springs and in all different types. There is a special indicator for ammonia pressures, another that is suitable for either steam or gas engines, another with electrical motion, etc. To become thoroughly familiar with all these types and to satisfy yourself as to which is the most suitable for your work, it would be well to send for a copy of this catalog. The Ashcroft Mfg. Co. also make the Coffin averaging planimeter and the Amsler planimeter as well as all indicator supplies, scales, etc. For information regarding gages, pipe stocks, dies and other articles made by this company send for their complete catalog.

WHAT IS PRACTICALLY the first complete catalog issued by the Murphy Iron Works, Detroit, Mich., is now out. The Murphy Iron Works manufacture the well-known Murphy automatic smokeless furnace. The catalog that they have issued is complete in every respect showing the construction is every particular by line drawings and half tone engravings. It is also as handsome a catalog as we have received and will make a valuable addition to any mechanical man's library. For a copy of this catalog address the Murphy Iron Works, Detroit, Mich., and mention the Engineers' Review.

"HOW TO OIL AN ENGINE" is the title of illustrated catalog No. 6, issued by Wm. W. Nugent & Co., 27 W. Randolph street, Chicago. This company manufacture Nugent's patent oiling devices, oil filters, tanks and pumps, also special oiling systems. As this company have been in the business for years their ideas on oiling will be of special interest to all our readers. A copy of the catalog will be sent by Nugent & Co. upon request.

AIRLIFT PUMPING is described in a small booklet issued by the Ingersoll-Sergeant Drill Co., 26 Cortlandt street, New York. It goes into the subject briefly, but if any of our readers wish to know more about the subject, catalog No. 73 entitled "Lifting Water by Compressed Air" will be promptly sent upon request.

ENGINEERS OF PLANTS in which water is taken from rivers, creeks or lakes for boiler feed are often troubled by the stopping up of the feedpipe by sticks, leaves, fish, etc. It was to overcome this difficulty that the L. & D. self-cleaning foot valve was invented and the first one made was used in the plant in which the inventor is employed. This foot valve has been in use for several years in various parts of the country and the manufactures have yet to receive a word of complaint as to its reliability. If the holes in the foot valve become stopped up, they can easily be cleaned out by reversing the flow of the water in the pipe. This can be done from the engine room. For further information address the L. & D. Foot Valve Co., 353 S. Front street, Grand Rapids, Mich.

A HANDSOME and interesting booklet describing Ideal engines and illustrating its various parts is at hand. The Ideal engine is manufactured by A. L. Ide & Sons, Springfield, Ill., who will send a copy of this booklet upon request.

THE MONTHLY RECORD of Scientific Literature issued by D. Van Nostrand & Co., 23 Murray and 27 Warren streets, New York, has been received. At this time they are calling special attention to the book "Internal Combustion Motors," by Prof. R. C. Carpenter and H. Diedrichs of Sibley College, Cornell University. For further information regarding this book address the publishers at either of the addresses above given.

"GRAPHITE," the monthly publication of the Jos. Dixon Crucible Co., of Jersey City, N. J., is in and as usual contains a great deal of matter of interest to the engineer. It is devoted particularly to lubrication by the use of graphite and as it is sent free to engineers there is no reason why you should not read it.

ONE OF THE HANDSOMEST CATALOGS that has been our pleasure to review has recently been issued by the DeLaVergne Machine Co., of New York, manufacturers of Koerting gas engines. The catalog, while being about as handsome as a catalog can be, is fully up to the mark in the matter of illustration and description. Any engineer desiring to increase his knowledge of gas engines, their construction and operation, should get a copy of this catalog. When writing kindly mention the Engineers' Review.

A UNIQUE and interesting booklet has been issued by the Consolidated Engine Stop Co., 100 Broadway, New York. The cover of the booklet represents the cover of a law book, while the back cover extends above the front cover and represents the head of a judge. The booklet is entitled "The Law of Employers' Liability" and very briefly states the decision of a case brought before the Supreme Court of Rhode Island. Every engineer, superintendent and manufacturer should acquaint himself with this decision and can do so by writing the Consolidated Engine Stop Co. at the above address.

: WILLIAMS GAUGE CO., Pittsburg, Pa., manu-
rs of the Williams safety feedwater regulator, also
cture the Williams steam pump governor and the
ıs steam trap. They will be pleased to give informa-
garding any of their appliances to any person address-
m.

: PUBLICITY MAGAZINE for June and July have
d each other rather closely. This magazine is pub-
by the Under-Feed Stoker Co. of America, Mar-
building, Chicago, and every month contains some-
f interest and value to engineers. It is designed prin-
to keep its readers in touch with the development and
in popularity of the Jones stoker. It will be sent
nonths free of charge to engineers who ask for it.

AM RECEIVERS AND SEPARATORS" is the title
reatise on this subject by Frank A. Simonds, Grand
Mich. It also describes the different types of the
ls separator. This separator is designed on a different
an any other on the market and is made especially to
conditions under which it is to operate. The ideas
ed by Mr. Simonds are worthy of consideration by
progressive engineer and plant owner.

HAVE RECEIVED a folder describing the book en-
the "Practical Gas Engineer," published by E. W.
ecker, 404 Madison avenue, Anderson, Ind. The price
book is $1 and can be obtained by addressing the pub-
or the Engineers' Review.

KENHEIMER MECHANICAL OIL PUMPS for
engines, pumps, automobiles, and traction engines are
described in a booklet that has been sent us. These
ps as well as the Lunkenheimer valves are well known,
nufactured by the Lunkenheimer Co., Cincinnati, O.

: TRIUMPH OIL SEPARATOR which is manu-
d by the Steam Appliance Co., 247 Oregon street, Mil-
, Wis., is illustrated and described in a booklet re-
received. To show their confidence in this separator
nufacturers agree to install the separator on a 60
trial with a very liberal guarantee. Engineers not
r with this separator should be and can obtain further
ation from the manufacturers.

KE'S SELF-CLEANING smokeless furnace, which
ufacturerd and for sale by Jas. V. Burke, 308 Adams
s building, Chicago, is fully described in a 40-page
A description and reports of tests of this furnace
of interest to most engineers.

T. BONNER & CO., Boston and New York, manu-
rs of Klinger reflex water gages and gage mount-
ve been incorporated under the laws of the state of
husetts and will hereafter be known as the Wm. T.
Co. This company have a very complete line of
specialties and will be glad to send their literature to
address them at 246 Summer street, Boston, Mass.

AMERICAN BLOWER CO., Detroit, Mich., manu-
rs of heaters, fans, blowers, engines, etc., also manu-
Morehead traps of the return or tank types. These
traps are described in catalog No. 165 which will be
any engineer upon request.

: WEBSTER FEEDWATER HEATER and chemical
, manufactured by Warren Webster & Co., Camden,
is fully described and illustrated in part 2 of their gen-
talog. This is of particular interest to engineers and
sent to anyone upon request.

FFALO TANDEM GAS ENGINES," is the title of a
issued by the manufacturers, the Alberger Co., Buf-
. Y.

EELER CO., Williamsport, Pa., manufacturers of
d water tube boilers, self-supporting steel stacks, etc.,
nt us a copy of their catalog.

TER ARCH FURNACE CO., First National Bank
g, Chicago, have handed us a copy of their catalog
ng the twin fire furnace.

: GREENE-WHEELOCK ENGINE which is manu-
d by the American & British Mfg. Co., Providence,
s described in a catalog sent us some time ago. This
is equipped with the Hill valve gear and is built in
tal and vertical types for any service and any size.
ompany also manufacture the Geo. H. Corliss steam
the Diesel oil engine and the O. K. kerosene engine.

IMPROVED WATER TUBE CLEANER" is the
a folder issued by the General Specialty Co., 73 Carroll street, Buffalo, N. Y., and describes the Demon water tube boiler cleaner. This cleaner was recently described in the Engineers' Review, but more detailed information is given in the folder.

THE GWYNN GAS BURNER, which is said to be one of the most successful natural gas burners, is illustrated by a blue print being sent out by the manufacturer, Mr. E. F. Gwynn, 800 Empire building, Pittsburg, Pa. In those sections of the country where natural gas is used, the Gwynn is well known.

A VERY INTERESTING BOOKLET entitled "About Myself," is a description of a Bundy steam trap. It gives a brief history of the trap and contains considerable information regarding the different purposes to which traps may be put. It will be sent to any one upon request by the A. A. Griffing Iron Co., 450 Communipaw avenue, Jersey City, N. J.

THE HEINE SAFETY BOILER CO., 420 Olive street, St. Louis, Mo., give a description of their boilers in a handsome catalog that has been received. This catalog, however, is devoted more particularly to illustrations of the plant and shops in which the Heine boiler is made.

CATALOG B, issued by the Pittsburg Valve & Fittings Co., Frick building, Pittsburg, Pa., is a very large and handsome one. This company manufacture iron pipe fittings, brass and iron valves, etc.

TRADE NOTES.

IT IS ANNOUNCED that W. S. Heger, for many years identified with Westinghouse interests, has joined the force of the Allis-Chalmers Co. as assistant to the vice president and general manager.

THE QUINCY ENGINE WORKS, Quincy, Ill., report an excellent business in their line for June. In addition to a dozen orders for "Quincy" corliss engines the company have just secured a contract for a large compound vertical automatic engine for a direct connected electrical unit. These orders, in addition to a large contract for special machinery for the United States Steel Corporation, seem to demonstrate beyond a doubt that the now famous "Q" for Quincy and "Q" for Quality seems to have struck a popular chord.

THE CRANE CO., Chicago, whose offices have been located at 10 North Jefferson street since 1864, have moved to their new office building at 519 South Canal street. A branch of the city sales department will be continued at the old address.

THE ROE-STEPHENS MFG. CO., Detroit, Mich., manufacturers of safety valves, throttle valves, gate valves, angle, globe and check valves and steam specialties, have bought of C. W. Thomas the plant and equipment of what was formerly the Michigan Brass and Iron Works. They also announce that they have secured the services of Charles A. G. Winther as general superintendent. Mr. Winther held a similar position with the Chapman Valve Mfg. Co., Indian Orchard, Mass., for many years.

THE CHANDLER & TAYLOR CO., Indianapolis, Ind., were the successful bidders for the 150-horsepower high-speed, self-oiling, direct connected engine which is to be placed in the new power plant of Mandel Bros., of Chicago.

THE FISHER GOVERNOR CO., 1202 Main street West, Marshalltown, Ia., report that orders are coming in thick and fast from all parts of the United States and that another order was received from Russia a short time ago. They manufacture the Fisher pump governor; also pressure regulators and reducing valves.

THE CRANE CO., Chicago, celebrated their 50th anniversary July 4. All the company's branch house managers took part in the celebration. Monday the branch managers went through the Crane Co.'s factories; in the evening, at 7 o'clock, they were given a dinner and taken to the "White City," where an evening was spent visiting the various shows. Tuesday morning the managers went to Lake Geneva, Wis., where they were entertained by Mr. R. T. Crane at his summer residence that and the following day, Thursday, July 6, the company gave to all their employes and families a picnic at North Western Park. About 10,000 people attended this picnic.

MR. W. A. STADELMAN, Eastern agent of the Wellman-Seaver-Morgan Co., and who has been in charge of the Eastern office at 42 Broadway, New York city, has been appointed general sales agent of the same company, with headquarters at Cleveland, O., taking effect July 1. Mr. Fred Stadelman has been appointed assistant manager of the New York office. Mr. Harry V. Croll, M. E., for the past eight years with the E. P. Allis Co., and their successors, Allis-Chalmers Co., of Chicago, has resigned and accepted a position with the Wellman-Seaver-Morgan Co., Cleveland, O.

THE MATTER OF SATISFACTORY lubrication is probably the most vexatious problem which comes before the general user of machinery. Those who have tested Albany grease, made only by Messrs. Adam Cook's Sons, 313 West street, New York city, usually find that it offers a relief along this line. The manager of a large laundry plant in Chicago writes: "The grease works very satisfactorily and we shall use it hereafter in preference to what we have had."

RECENT SALES of the White Star oil filter by the Pittsburg Gage & Supply Co., Pittsburg, have been made to the following: Page Coal & Coke Co., Pageton, W. Va.; General Castings Co., Verona, Pa.; Atlantic Elec. L. & P. Co., Atlantic City, N. J.; A. Weston Lbr. Co., Weston Mills, N. Y.; Merchants Mfg. Co., Fall River, Mass., and the American Zinc, Lead & S. Co., Carterville, Mo.

THE INGERSOLL-SERGEANT DRILL CO. and the Rand Drill Co. have been united into a new company called the Ingersoll-Rand Co. The new incorporation was formed under the laws of New Jersey with a capital of $10,000,000, of which $5,000,000 is preferred stock and the balance common. This is a union of valuable patents and of expert engineers of large experience in their special line of work. It should be advantageous to purchaser as well as manufacturer. Improved machinery and better service will result. The factories of the two companies are located at Phillipsburg, N. J., Easton, Pa., Tarrytown, N. Y., Ossining, N. Y., Painted Post, N. Y., 34th street, New York city, and Sherbrooke, Quebec. They will all be operated. For the present the main offices of the new company will be located at 26 Cortlandt street, New York.

THE WILLIAMS GAGE CO., Pittsburg, Pa., wish to announce the establishment of their Chicago office in the Fisher building. It is conducted by Mr. F. E. Gould, who will be pleased at all times to receive inquiries and give any information on the several specialties manufactured by the above concern. They report the equipment of feed-water regulators to over 3,000,000 horsepower of boilers, and their steam trap is used in some of the largest plants in the country.

THE WALTER L. FLOWER FILTER CO., 1011 Chemical building, St. Louis, Mo., report that they have recently shipped 34 Acme oil filters to Kobe, Japan, and are preparing a shipment of 26 which will go forward to the same place soon.

THE STIRLING CO. announce the removal of their executive and accounting departments from the Pullman building, Chicago, to the Trinity building, New York City, on May 1, 1905. They will continue, however, to maintain their present offices in the Pullman building, Chicago, for the convenience of their friends and trade in the West.

IT HAS BEEN ANNOUNCED that the Gem Mfg. Co., Pittsburg, Pa., have sold the boiler tube cleaner business to the Lagonda Mfg. Co., Springfield, O. This latter firm need no introduction to the readers of the Engineers' Review.

THE G. M. DAVIS REGULATOR CO., Chicago, New York, San Francisco and Boston, have recently received an order for a 30-inch combination back pressure and relief valve to be installed on the exhaust pipe of the Sears-Roebuck new plant in Chicago. This valve is so arranged as to hold either a back pressure or a high vacuum and it is the intention of this company to run condensing in the summer on the heavy-duty cross-compound Reynolds Corliss engines and in the winter to run non-condensing and utilize the exhaust for heating. The combination valve automatically adjusts itself to either condition. This company also report that in the past year they have furnished 125 of these combination valves ranging in size from 12 to 30 inches used in connection with Curtis turbines where it is desired to run them condensing or non-condensing. They also mention a recent shipment of an 18-inch No. 2 high pressure regulator to Cuba. This is the largest pressure reducing valve that has been made for some time, it being the second one that this company has put out.

THE BURT MFG. CO., Akron, O., have just received a very flattering testimonial from the DeLaval Steam Turbine Co., in reference to the large American oil filter which they used in their exhibit at the St. Louis Exposition.

The Relief Valve.

A buzz—a whirr
A cloud of dust—
A wild, blood-curdling yell—
A ghastly object flashing by—
Then silence—and a smell!

There are no buffet cars on a train of disasters.

In Adam's day, woman was merely a side issue, but at the present writing she is pretty much the whole show.

The coal man should be brought to see the error of his weighs.—*Philadelphia Record.*

"I see that Russia is putting another large sum into a new navy."

"Yes, that's her sinking fund."—*Life.*

A pupil in a Lynn, Massachusetts, school was asked by his teacher to give the definition of a vacuum.

"I can't just describe it," said he, "but I have it in my head."—*Lippincott's.*

"I want some one to figure out how much electricity it is going to take to run my mill. Whom would you recommend?"

"One of those lightning calculators, of course.—*N. O. Times-Democrat.*

"It's a wonder that stock hasn't taken a tumble," said the first speculator. "It's going up steadily, although I believe it's full of water."

"But," remarked the other, "how can it be full of water if there isn't a drop in it?"—*Philadelphia Press.*

"It's really very kind of you, Mr. Dumley, to give me your seat," said Miss Koy.

"Not at all," replied Dumley. "We men are getting very tired of being accused of giving up our seats only to pretty girls."—*Philadelphia Ledger.*

Bill had a billboard. Bill also had a board bill. The board bill bored Bill so that Bill sold the billboard to pay his board bill. So after Bill sold his billboard to pay his board bill the board bill no longer bored Bill.—*From the Yale Expositor.*

Smith—"Why is Brown carrying his arm in a sling?"

Jones—"Oh, his horse kicked him and broke it. He went out horseback riding the other day instead of taking his automobile; and when the horse balked, he got off and twisted its tail—from force of habit, you know."—*The Automobile.*

Mrs. Cassidy—Yer drunk, ain't ye? Where's yer hat?

Cassidy—Whin Oi left Casey's Oi seen two hats on the table. Oi picked up wan o' thim an' put it on me head. Faix, Oi musht 'a' picked up the wan that wasn't there!

A lawyer had as a client a negro who was accused of stealing chickens. Things were going in the darkey's favor, until he was placed on the stand.

"Are you the defendant in this case?" asked the judge.

"No, sah," he replied, with an amazed look on his face and pointing to his counsel, "dat man over da, he's de defendant; I'se de gem'an what stole de chickens."

At one of the railway construction works in Glasgow, a Roman Catholic clergyman, who takes a great interest in the members of his flock engaged at the cutting, saw one of them entering a saloon. He hailed him, but Pat simply looked, and walked in. Waiting till he came out, the reverend gentleman accosted him thus: "Pat, didn't you hear me calling?" "Yes, your rivrince, I did, but—but I had only the price of one."

Can Get Those Boilers Clean
If You Use

INTERNATIONAL
Boiler Compound

ou doubt it, send for a trial order.
have a special proposition for engineers. Write for it.

rnational Boiler Compound Co.
arket Street, CHICAGO, ILL.

A CHEAP AND SIMPLE DEVICE THAT WILL SAVE YOU LOTS OF TROUBLE AND MAY PREVENT AN EXPENSIVE SHUT-DOWN

An Automatic Self-Cleaning FootValve

You can clean it quickly and thoroughly without leaving the engine room.

No plant taking its boiler feedwater from a river, lake or pond can afford to be without this valve

GIVES SATISFACTION WHEREVER USED
SEND FOR CIRCULARS AND PRICE LIST

L. & D. FOOT VALVE CO.
353 S. Front Street GRAND RAPIDS, MICH.

orth Wins" AND THE
olden Tilting Steam Trap

on its merits. Made for high or low pressure. It is the gest trap of its kind on the market. No floats, no valves inside p to get out of order. Positive and durable.

'e wish to call special attention to the Anderson Non-Return , description of which will be found in our catalog Send for it.

Golden-Anderson Valve Specialty Co.
PIKE ST. PITTSBURG, PA.

This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

THE USE OF THE
Reliance Safety Water Column
INSURES, AMONG OTHER THINGS
Steady Water **Less Repairs**
Steady Power **Less Stoppages**
Steady Steam Pressure **Less Fuel**
Less Expansion and Contraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

WRITE US FOR FURTHER INFORMATION

The Reliance Gauge Column Co.
86 E. PROSPECT ST. CLEVELAND, O.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.
SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.
Albany, N. Y., U. S. A.
Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

STEAM PIPES THAT SPATTER ROOFS

Does this suggest a condition that exists in your own plant? A constant drizzle of oil and water from the exhaust pipe. Decay of roof. Spattered walls. Wet sidewalks. Annoyance to passersby and injury to their clothes.

A Wright "CYCLONE" Exhaust Head Would Stop All This!

The "CYCLONE" is a perfectly proportioned head. Extremely heavy and durable, and made to last for years. It cannot cause back pressure, all steam passages being ample, giving a full, free course to the steam, which issues light and dry and without noise.

Don't buy an exhaust head until you have studied the construction details of the WRIGHT "CYCLONE" **Send for leaflet.**

WRIGHT MANUFACTURING CO.

82 Woodbridge St. - - - DETROIT, MICH., U. S. A.

PAT. AUG. 16, 1904.

16 inch Swartwout Cast Iron Exhaust Head on the 16 story Columbus Savings & Trust Company's Building, Columbus, Ohio.

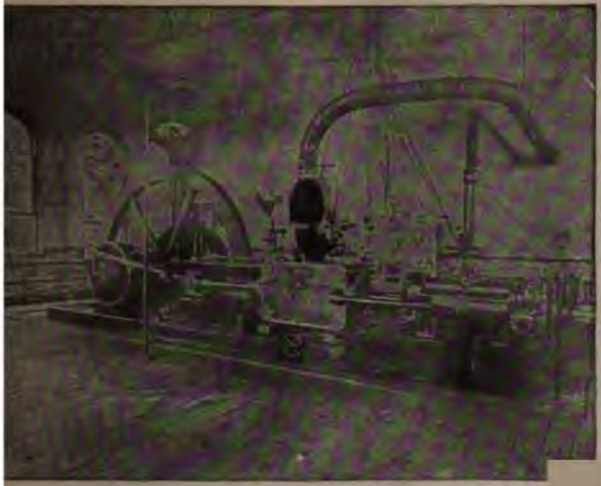
FRANK L. PACKARD
COLUMBUS, OHIO
ARCHITECT

It is ornamental and is there to stay - -

THE OHIO BLOWER COMPANY,

SOLE MANUFACTURERS.

CLEVELAND, Dept. S3 OHIO



THE LAST CHANCE

to take water out of Live Steam is at the throttle. We make several styles of

AUSTIN
Steam Separators

designed to be installed as shown above, giving

Three Great Advantages

Fig. "H" Vertical

DRY STEAM — Increased efficiency in the engine. Over 99.5% dry steam proven by test.

STEAM STORAGE—Extra steam instantly available for sudden increases of load. In many plants the use of a steam separator that also acts as an accumulator is invaluable.

ENGINE INSURANCE—A large Austin receiver separator properly drained—for this purpose use a good steam trap—gives absolute protection against water entering the engine cylinder either in large or small amounts.

Figured in any of these three ways an Austin Separator earns steady dividends on its cost. And we let you prove it to your own satisfaction before a cent of money changes hands. Catalogue illustrates and details the complete Austin line of separators for live or exhaust steam. *SEND FOR IT.*

Austin Separator Co.

90 Woodbridge St., Detroit, Mich., U. S. A.

The Standard Steam Trap of America

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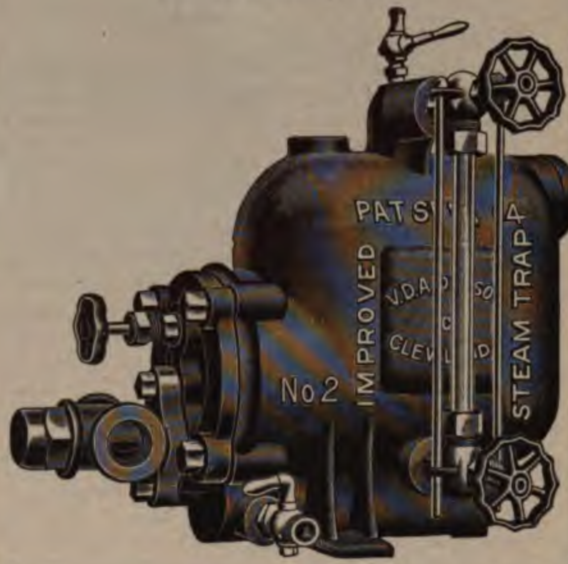
MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.



MOUND PACKING TOOLS

Will go in any valve, rod pump or engine stuffing box. Will withstand roughest usage.

1 set of 4 Locking Tools.....$1.50
1 set of 6 Packing Tools..... 2.25
1 set of 5 Cold Chisels........ 2.00

Mail orders promptly attended to. Get our book Engineers' Chums.

MOUND TOOL & SCRAPER CO., 710-712 Howard St., ST. LOUIS, MO.

CRANE VALVES

ESTABLISHED 1855

ENGINEER'S LICENSE

"THE HAWKINS' WORKS"

are the most helpful series of books published for **Engineers and Firemen,** relating to a safe and sure preparation for examination for Engineer's licenses and promotions.

Complete Catalogue sent free, write to-day.

THEO. AUDEL & CO.
63 Fifth Ave., New York City.

Just Read These Two Letters

From the Eureka Fire Hose Co., and be convinced that the Cross Oil Filter is every bit as good as we say it is:

Jersey City, N. J., May 20, 1895.

The Burt Mfg. Co., Akron, Ohio.

Gentlemen:—We take pleasure in certifying that the Oil Filter purchased about two years ago has given good satisfaction.

Yours very truly, Eureka Fire Hose Co.,
B. L. Stowe, Vice-Pres.

HERE IS WHAT THEY SAY AFTER ALMOST ELEVEN YEARS:

Jersey City, N. J., March 9, 1904.

The Burt Mfg. Co., Akron, Ohio.

Gentlemen:—We do not have much oil to filter, but the Cross Filter that we purchased of you eleven years ago filters satisfactorily all that we put into it.

Yours truly, Eureka Fire Hose Co.,
B. L. Stowe, Vice-Pres.

Here's pretty good evidence that the Cross Oil Filter gives satisfaction—and gives it for a long time. Wouldn't it be a good plan for you to find out more about such a filter? We know it would and we want to send you the booklet.

Here's Another Proof

that our Standard Exhaust Head is all that we claim it is—and more:

Leetonia, Ohio, January 14, 1905.

The Burt Mfg. Co., Akron, Ohio.

Gentlemen:—Your esteemed favor of the 13th inst. is received, and replying thereto we beg leave to advise you that the 37½" Standard Exhaust Head we purchased from you, and have had it in use for about 60 days, is giving us good satisfaction. We find the exhaust head all and more than you claimed for it.

Yours truly,
THE SALEM IRON CO.

This Exhaust Head was made of No 10 gauge iron, and weighed 4,200 lbs. We make them of any weight of iron desired, and in any size from one inch to sixty inches. An interesting booklet will be sent on request.

THE BURT MANUFACTURING CO.

Largest Manufacturers of Oil Filters in the World.

228 Main Street, AKRON, OHIO, U. S. A.

Also Supplied by Engine Builders, Dealers and Power Contractors.

GOLD MEDAL
ST. LOUIS, 1904

Try the Trimo

One thorough trial will convince you of the superior merits of the Trimo Pipe Cutter.

The rolls keep the cutter straight automatically, ensuring a square cut. At the same time they remove all burr, leaving the pipe ready for the threading die. No filing is necessary. Thus a great saving of time and labor is effected.

For close quarter work the rolls can be replaced by cutting wheels, making a 3-wheel cutter.

Another strong point is the absence of thread in the handle bearing. An easily replaced nut is used instead.

Send for catalog No. 22, or consult your dealer.

TRIMONT MFG. CO.

Dept. C. **Roxbury, Mass.**

ALPHABETICAL LIST OF ADVERTISERS.

The following list gives the pages on which the advertisements appear.

For classified list of machinery, etc., see page 44.

Albany Steam Trap Co. 39
American Engine Co. 66
American Injector Co. 54
Anderson Co., V. D. 41
Arizona Corporation Charter Guarantee Co. 66
Armstrong Mfg. Co. 57
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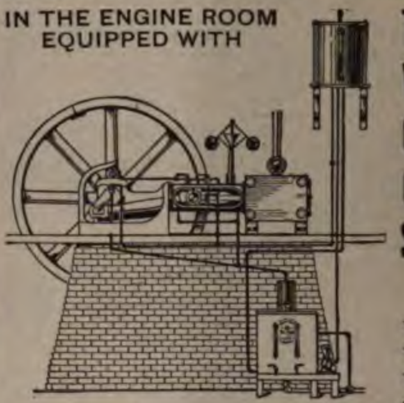

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There is waste of o waste of tim waste of was oil-soak floors; or bearings running hot.

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OIL FILTRATION EXPERTS.

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Cooling Towers
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Cutters, Gasket and Washer
McCrea & Co., Jas.
Cutters, Tube
Lagonda Mfg. Co.
Cylinders, Artesian Well
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Dust Collectors
Ohio Blower Co.
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Fittings, Brass Hydr
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Chicago Rawhide Mfg. Co.

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Martin Grate Co.
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Lubron Mfg. Co.

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Bates Machine Co.

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Bates Machine Co.
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Harrison Safety Boiler Works
Jacobs & Co., Chas.
National Pipe Bending Co.
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Robertson & Sons, Jas. L.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

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National Pipe Bending Co.
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Heating Apparatus
Ohio Blower Co.

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Goodyear Tire & Rubber Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Indicator Instruction
Indicator Instruction Co.

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Indicators, Steam Engine
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Lippincott Steam Spec. & Supply Co.
Robertson & Sons, Jas. L.

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Chicago Injector Co.
Hancock Inspirator Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.

Inspirators
Hancock Inspirator Co.

Lace Leather
Chicago Rawhide Mfg. Co.

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Starrett Co., L. S.

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American Injector Co.
Chicago Injector Co.
Detroit Lubricator Co.
Greene, Tweed & Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.
Sterling Lubricator Co.
Williams Valve Co., D. T.

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Lunkenheimer Co.

Machinery, Oil Mill
Anderson Co., V. D.

Machines, Drilling
McCrea & Co., Jas.

Machines, Electric Boring
McCrea & Co., Jas.

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Starrett Co., L. S.

Mill Equipment, Wire
Bates Machine Co.

Motors
American Engine Co.

Nail Machines, Wire
Bates Machine Co.

Nail Rumblers
Bates Machine Co.

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Chicago Injector Co.
Detroit Lubricator Co.
France Packing Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Merrill, G. U.
Penberthy Injector Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Oils
International Boiler Compound Co.
Lubron Mfg. Co.
Standard Oil Co.
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France Packing Co.
Goodyear Tire & Rubber Co.

Packing, Rawhide Hydraulic
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Greene, Tweed & Co.
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Quaker City Rubber Co.
Robertson & Sons, Jas. L.

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Wheeler Condenser & Eng. Co

Pumps, Centrifugal
Wheeler Condenser & Eng. Co.

Pumps, Oil
Greene, Tweed & Co.
Lunkenheimer Co.
Penberthy Injector Co.
Sterling Lubricator Co.

Pumps, Power
Myers & Bro., F. E.
Quincy Engine Wks
Stewart Heater Co.

Pumps, Steam
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Canton Pump Co.
Lippincott Steam Spec. & Sup. Co.
Snider-Hughes Co.
Wagener Pump Co.
Wheeler Condenser & Eng. Co.

Pumps, Vacuum
Wheeler Condenser & Eng. Co.

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Penberthy Injector Co.

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Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

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Davis Regulator Co., G. M.
Lagonda Mfg. Co.
Robertson & Sons, Jas. L.

Regulators, Feedwater
Lagonda Mfg. Co.
Merrill, G. U.

Regulators, Pressure
Davis Regulator Co., G. M.
Foster Engineering Co.

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Saws, Hack
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Austin Separator Co.
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Flower & Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
Lippincott Steam Specialty & Sup. Co.
Ohio Blower Co.
Robertson & Sons, Jas. L.
Stewart Heater Co.

Squares
Starrett Co., L. S.

Staple Machines
Bates Machine Co.

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Anderson Co., V. D.
Davis Regulator Co., G. M.
Lagonda Mfg. Co.
Lunkenheimer Co.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Reliance Gauge Column Co.
Williams Valve Co., D. T.
Wright Mfg. Co.

Stokers, Mechanical
Aultman & Taylor Mch. Co.
Model Stoker Co.

Strainers
L. & D. Foot Valve Co
Merrill, G. U.

Superheaters
Aultman & Taylor Machinery Co

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France Packing Co.
Lippincott Steam Spec. & Sup. Co.
Reliance Gauge Column Co.

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Starrett Co., L. S.

Tools, Scraping
Mound Tool & Scraper Co.

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Wright Mfg. Co.

Traps, Steam
Albany Steam Trap Co.
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Davis Regulator Co., G. M.
Flower & Co., Walter L.
Golden-Anderson Valve Specialty Co.
Lagonda Mfg. Co.
McCrea & Co., Jas.
Ohio Blower Co.
Reliance Gauge Column Co.
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Trimmings, Engine and Boiler
Powell Co., Wm.

Tubing
Quaker City Rubber Co.

Unions
Albany Steam Trap Co.
Powell & Co., Wm.

Valves
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Crane Co.
Davis Regulator Co., G. M.
Foster Engineering Co.
Golden-Anderson Valve Specialty Co.
Hancock Inspirator Co.
Lubron Mfg. Co.
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Valves, Back Pressure
Davis Regulator Co., G. M.

Valves, Blowoff
Lagonda Mfg. Co.
Pittsburg Gage & Supply Co.
Powell Co. Wm

Valves, Gate
Golden-Anderson Valve Special Co.
Lunkenheimer Co.

Valves, Foot
L. & D. Foot Valve Co

Valves, Non-return
Golden-Anderson Valve Special Co.

Valves, Pump
Lubron Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Valves, Reducing
Foster Engineering Co.
Golden-Anderson Valve Specialt Co.

Valves, Tuyere
Lunkenheimer Co.

Varnish
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Engineers' Review Co.

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Pittsburg Gage & Supply Co.
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Lord Co., Geo. W.

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Lunkenheimer Co.
Powell Co., Wm.
Williams Valve Co., D. T.

Wire Pointers
Bates Machine Co.

Working Heads
Myers & Bro., F. E.

Wrenches
Trimont Mfg. Co.

ıd These Two Letters, Mr. Engineer, Please

HE KANSAS CITY STAR'S PAPER MILL.
Kansas City, Mo., Apr. 18, 1905.
VM. B. PIERCE CO.
LEMEN—Since you repeatedly insist that we give your
Boiler Tube Cleaner a trial I will make you the fol-
offer.
u care to send me, express or freight prepaid, your
Cleaner with the understanding that I am to give it a
' trial and will be under no obligation whatever to
the end of the time *"even if it does prove satisfac-*
ou may send it.
ld you not care to accept this offer kindly let this
nd the correspondence as I have very little interest
My boilers are clean, use filtered distilled water prac-
ınd do not need your cleaner, and further I understand
is device expands the tubes and makes it almost im-
to remove same after they have been cleaned a few
ith it.
ing that you may find something in the above propo-
hat will suit you, I remain

Yours very truly,
D. E. WASHINGTON, Supt.
The Star Paper Mill Co.

Dean Cleaner illustrated here was sent.

For Return Tubular Boilers.

For Water Tube Boilers.

THE FOLLOWING LETTER WAS RECEIVED IN REPLY TO OURS AFTER TRIAL PERIOD HAD EXPIRED.

Kansas City, Mo., June 3, 1905.

THE WM. B. PIERCE CO.

GENTLEMEN—In answer to your letter of June 1 we beg to say that we will keep the Dean Boiler Tube Cleaner, and payment will be made on the 10th of this month.

Very truly,
THE STAR PAPER MILL CO.
By P. W. SMITH.

Just think of it.

No scale and use filtered distilled water yet purchases the Dean Cleaner after trial.

This is but one of dozens of similar cases which fill our files, and which should be conclusive evidence that one really does not know that they have no scale until they use the Dean Cleaner.

Let us send you today "Boiler Room Economy," a pamphlet which tells all about scale and the Dean Cleaner.

Write for it today.

THE WM. B. PIERCE·CO.,
325 Washington St., Buffalo, N. Y.

CENTURY

The Original White Packing.

R SALE BY LEADING SUPPLY HOUSES.

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You can add some fine engineering books to your library by a few moments work.

We wish to know when new machinery is to be purchased and pay liberally for the information.

Write us for circular which will explain our plan in full.

INFORMATION BUREAU
ıgineers' Review, Cleveland.

The Wise Engineer's First Talk :--

Say, those Lagonda People are all right. They know three things anyway, and that's a heap more than a lot of us know. For one thing they know how a boiler-tube cleaner ought to be built. Their

Weinland Tube Cleaner

cuts out scale that those "nearly" cleaners can't touch. Saves water, too. It's the best machine of the bunch. They prove it too, by cleaning boilers on contract with it or Power Driven Cleaner if you'd rather.

Then their Lagonda Tube Cutter—a dandy—makes a good clean cut anywhere in a tube—no bend, no burr, no bother. And talking of cutters—that Lagonda Damper Regulator beats the purchasing agent at cutting coal bills. Stops a heap of wastefulness.

You'll learn things you ought to know if you get Lagonda printed matter.

THE LAGONDA MFG. CO.

Boiler Cleaning Experts. At it 20 Years.

SPRINGFIELD, OHIO.

New York Chicago Pittsburg Philadelphia St. Louis London, Eng.

THE "LIGHTNING" TUBE GLEANER

Takes the Scale off QUICK inside and outside.

WARRANTED

To do the work in less time.
To cost least to keep it in repair.
To save ⅔ your water bill for cleaning.
To operate successfully by air, steam or water.

SEND FOR 7 REASONS WHY THE "LIGHTNING" DOES THE ABOVE.

Manufacturers of Boiler Head Cap and Nut Reseater and Cleaner, Perfect Expansion Flue Brush and X-Ray Oil Filter, etc.

MAURER, LABADIE & CO.

215 ST. JOE STREET, SOUTH BEND, IND.

HUSTLING STATE AGENTS WANTED

THE FAMOUS PHOENIX FLUE CLEANER

Has Six Adjustable, Self-Sharpening Interlocking Steel Blades with Bevel Edges. Doing perfect work even in spliced flues, Sent on trial and are delivered,

Hubbard & Co.
WASHINGTON, D. C.

Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.

Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. **Room 13, 74 Frankfort Street, CLEVELAND, OHIO,**

Lubron Packings

are specially treated with

(TRADE)
LUBRON.
(MARK)

They outwear and outlast all others and are self lubricating. If your packings give you trouble send us an order. If your packings work all right try ours once, they will work better. The only fault we find with our goods is that they wear too long.

THE LUBRON MFG. CO.

88 Broad Street,
Dept. 8. BOSTON, MASS.

30 DAYS' TRIA
TO PROVE OUR CLAIM

Ruggles Perfectio
Flue Cleaner

will quickly prove its worth in any plant.

It is the simplest cleaner on the market—being made of two parts.

No screws or rivets used in its construction. Sharpens itself. Absolutely cleans the flue. It is strong and reliable.

Send for one on trial.

RUGGLES & RUGGLE

Batavia, Illinois.

"Noiseless Running."

Chicago Rawhide Gears and Pinions

"Original Rawhide."

Rawhide Hydrauli Packi

It is anti-frictional and th durable on the marke

The Chicago Rawhide Mfg. Co.

SEND FOR CATALOGUE *71 Ohio Street, Chicago*

If you want the Best Ge

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Gould's *Steam and W* PACKIN

In ordering give *exact* diameter of St Box and Piston Rod or Valve Stem.

See that our name and trade mark every package.

Ring Packing.

Gould Packing Co.

ALBION CHIPMAN, Treas.

East Cambridge, MASS.

THE

y Perfect Packing

GOODYEAR
AKRON
METALLIC

GUARANTEED
For Piston Rods, Valve Stems, Pumps, Etc.

Our
Everlasting
Sheet

For Ammonia and High Pressure Stands Alone.

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Tip Top (red)
For Regular Use

OR OUR SPECIAL LIST OF PREMIUMS

We give all "A SQUARE DEAL"

oodyear Tire & Rubber Co.
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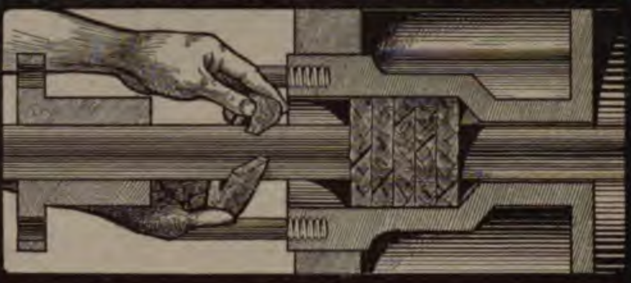
r, - - 78 Larned St., West, Detroit, Mich.
- - - - 110 Lake St., Chicago, Ill.
- - - 253 West 47th St., New York City.
- - - 6-8 Merrimac St., Boston, Mass.

WHAT GOES IN ~ ~ MUST COME OUT



Now and then, every engineer must re-pack his stuffing boxes, but the longer between re-packings the better he likes it. Put

CRANDALL
PACKINGS

in stuffing boxes and they are there to stay—long enough to satisfy any engineer, no matter how exacting the conditions may be, high speed, high pressure, high temperature, it is all one as far as Crandall Packings are concerned. Try them and see.

We make all kinds—

Ring,
Coil and
Spiral.

A Crandall Catalog, new edition, just about ready, yours for the asking.

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PALMYRA, N. Y.

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136 Liberty Street

CHICAGO
52 W. Washington St.

Pacific Engineering Co., Seattle, Wash., Pacific Coast Agents.

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PLANIMETERS, REDUCING WHEELS, OILING SETS, COLD CHISELS, PACKING TOOLS, GAGE GLASS CUTTERS, PIPE TAPS, HAND BLOW TORCHES, SPEED INDICATORS, VALVE RESEATING MACHINES and 500 other useful and desirable tools and articles

Absolutely Free

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France Packings have been on the market for years and are used on the largest engines and in the largest plants in the world.

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PHILADELPHIA, PA.

COUPON 000063

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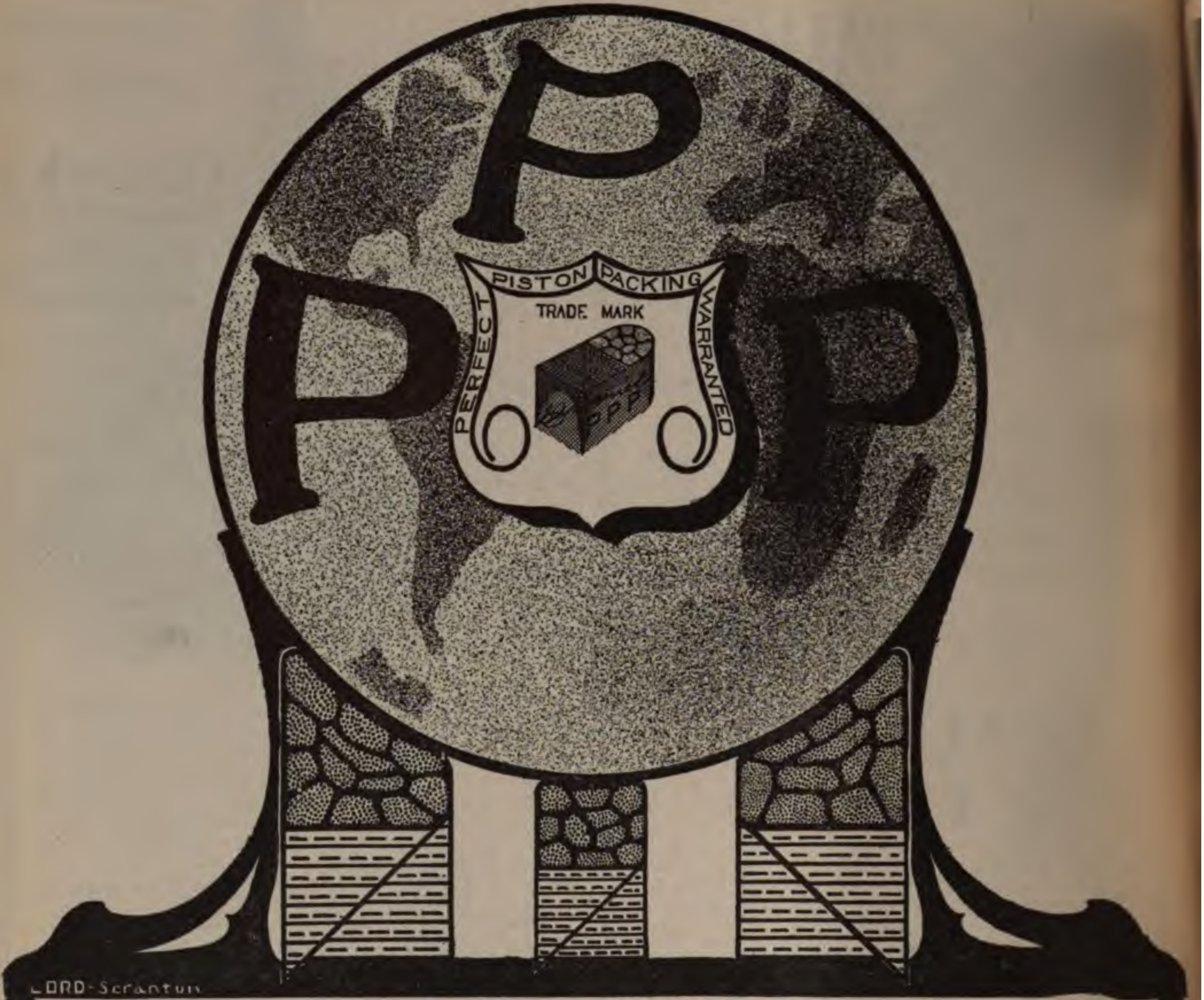

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with our course of Indicator Instruction (by mail) will soon be withdrawn. If you are an engineer desirous of learning indicator work "to a finish," and wish to get a fine Indicator outfit to practice with, you should read our ad in the Engineers' Review for March, and then write for further particulars, which are free. Address

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THE SOOT SUCKER draws the soot from the tubes without admitting steam into them.

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Will positively force any desired quantity of oil to steam chest or cylinder of engine.

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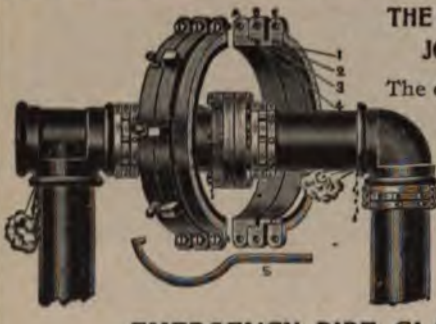

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The only perfectly satisfactory injector for traction engines. If feed should be interrupted it restarts automatically, the minute suction hose reaches water.

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2,000,000 Horse Power in Daily Use.

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Threads pipe from 1 to 2 inches inclusive

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For Hand or Power.

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It works in any position.

It never stops the flow of water.

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Steam Turbine users cannot afford to be without it.

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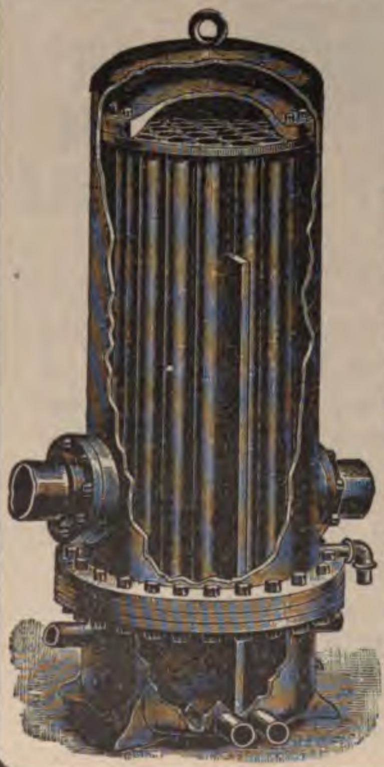

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Has a CAST IRON shell which will never wear out; with seamless drawn brass tubes expanded into tube plates at top and bottom, with double blow-off.

The tubes being surmounted by a cap, forming a chamber at the top, and being fastened rigidly only to the lower tube plate, free play is given for expansion, thereby preventing rupture and leakage of joints.

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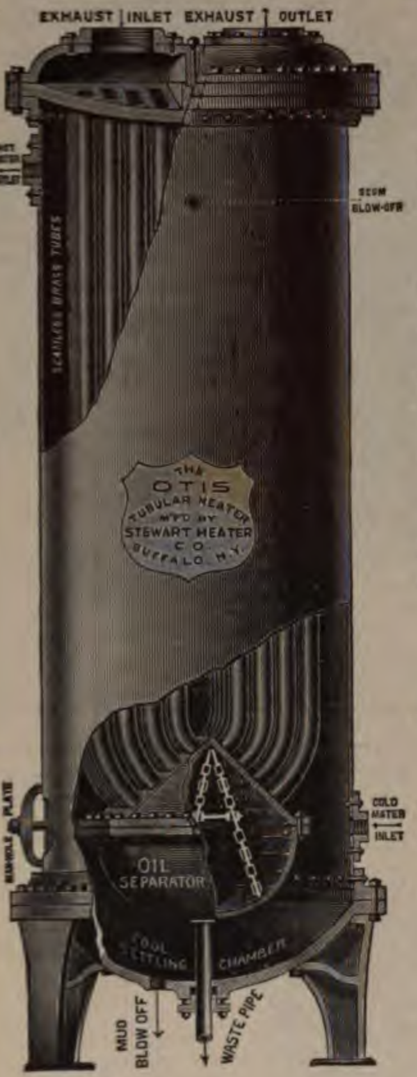

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A feed water heater will put the water into you boilers at boiling point, thus reducing the amount of fue used. A good heater should pay for itself in a short time

THE OTIS TUBULAR FEED WATE HEATER AND PURIFIER.

Is guaranteed to heat the feed water to the boiling poin (210° or 212°) with the exhaust steam without causin back pressure. It will also extract the oil from the ex- haust so that the exhaust steam can afterward be used fo heating purposes and the water of condensatiou from the heating system be returned to the boilers free from oil.

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While these pumps are of the double plunger type they can be run as double pumps or as two distinct singl pumps.

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The pump with the fewest working parts is the less liable to get out of order. For that reason we have designed our pumps along the line of simplicity.

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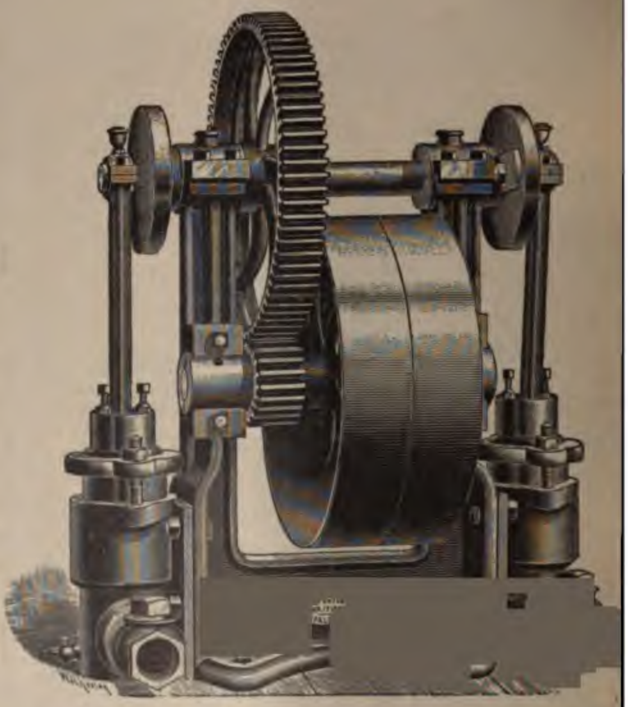

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The tubes are furnished with plain ends packed with the usual packing and secured by brass ferrules. This makes the removal of a tube, should it be necessary, easy and simple.
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They wanted to utilize their exhaust to the fullest possible extent—they wanted the highest temperature under all conditions, year in and year out—with the heater clean or full of scale—with a limited quantity of steam—or with plenty of it.

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These "Cochranes" saved water for them—roughly 15% of the entire quantity used by the boilers—while also giving them the chance to save their live steam drips and other returns without extra tanks or pumps. They also saved the heat that was in this water.

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Require less attention, fewer repairs and give better satisfaction than any other pump on the market on account of their

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THE MONITOR DUPLEX BOILER FEEDER

Diameter of Steam Cylinders	Diameter of Water Pistons	Length of Stroke	Capacity	
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3	2	3	100	20
4½	2¾	4	200	40
5¼	3½	5	350	70
6	4	6	500	10
7	4	8	600	12
7	4½	8	750	16
8	4½	10	900	17
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For hot water boiler feeding under high pressure, t MONITOR DUPLEX OUTSIDE CENTER PACK PUMP, illustrated below, is especially desirable.

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BY USING A

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on your Steam Pump. Positive in its action. Prevents an over pressure in the tank or discharge main. For Hydraulic Elevators, Fire, Boiler Feed and any pump where the discharge pressure is to be regulated. If you want to know more about them write.

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Belongs in the class of modern mechanical devices that seeks to reduce human responsibility. It makes a steam pump regulate its own work according to the volume of water discharged. so that it will neither race nor creep.

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is controlled by the discharge from the pump, is simple and correct in construction and faultless in application.

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Wagener Duplex Steam Pumps

Adapted to every requirement of the modern power house.

Let us send you our Catalogue for reference. Some time you will need it.

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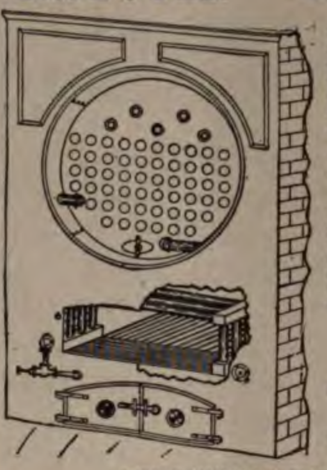

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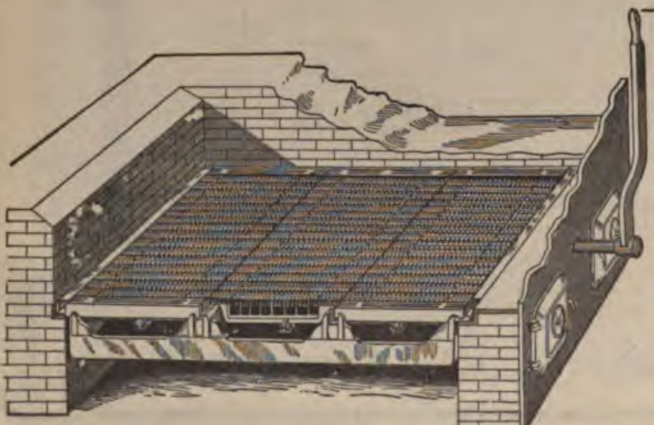

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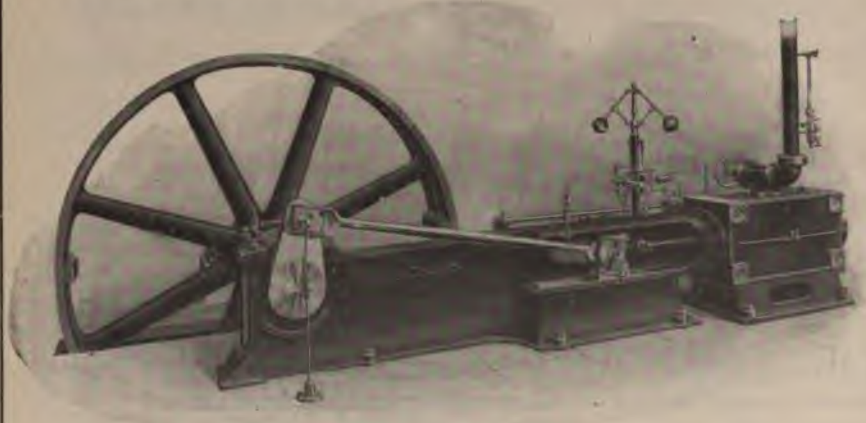

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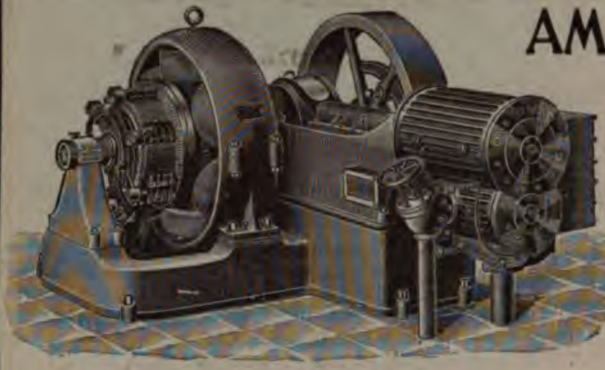

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ENGINEERS' REVIEW

Vol. 16
No. 8.

CLEVELAND, AUGUST, 1905.

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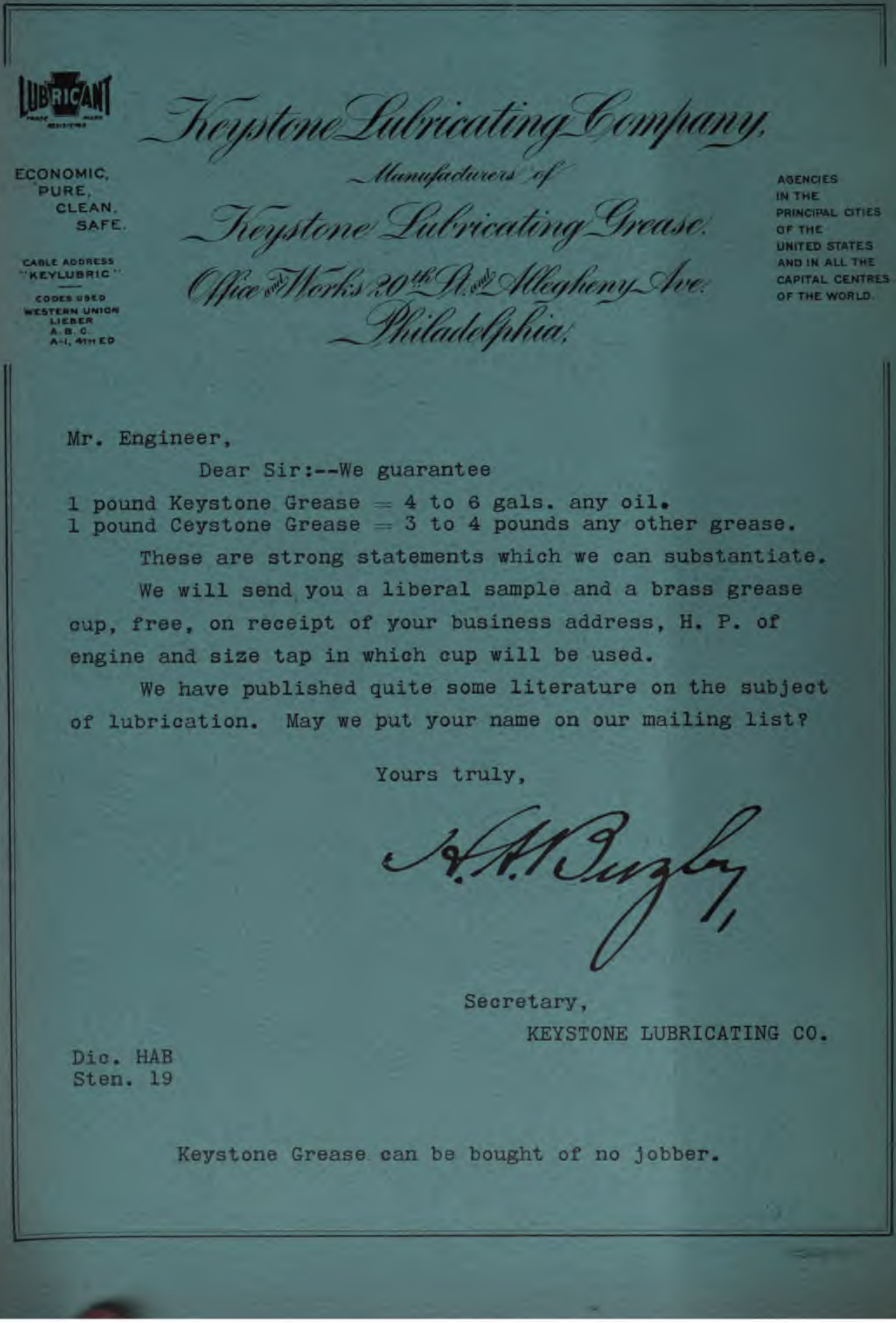

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ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

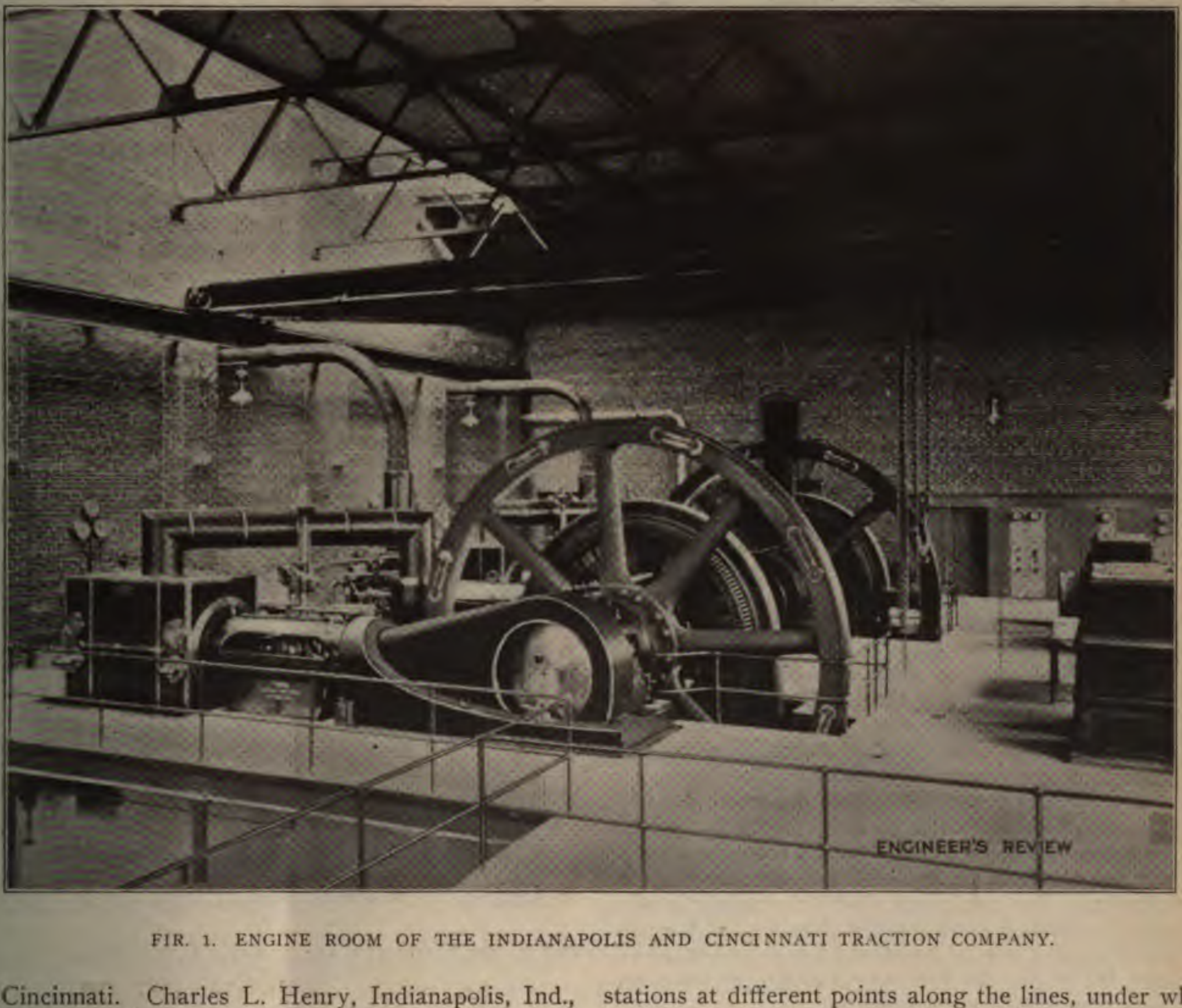
VOL. 16. CLEVELAND, AUGUST, 1905. No 6.

THE INDIANAPOLIS AND CINCINNATI TRACTION COMPANY.

The Indianapolis and Cincinnati Traction Co. as organized by a syndicate of Indiana people on the ourth day of February, 1903, under the laws of Indi-na, for the construction of an electric traction line rom the city of Indianapolis via Rushville and Con-ersville, Indiana, and Hamilton, Ohio, to the city f Cincinnati. Charles L. Henry, Indianapolis, Ind., s president and general manager of the company.

Mr. Henry built the first interurban electric road n Indiana in the year 1897, from Anderson to Alex-ndria, the first car being run between the two cities n Jan. 1st, 1898. He called this road an "Interur-an," thus coining a new word which has since become he common name for all electric roads connecting ities.

This road was part of a general plan of electric oads first formed by him in 1893 and afterwards completed in 1900 by the Union Traction Co. of Indiana with him as general manager, embracing a line of roads from Indianopolis via Anderson to Muncie, from Anderson via Alexandria to Marion, and from Alexandria to Elwood, a total of about 100 miles of interurban road. This system including also about 50 miles of the city lines in Anderson, Marion and Muncie, was, under his management, furnished with power from a central power station at Anderson, with sub-stations at different points along the lines, under what is known as the "three-phase alternating current system," the alternating current being transformed at the various sub-stations by rotary converters into direct current. The entire electrical equipment was furnished by the Westinghouse Electric and Manufacturing Co.



FIR. 1. ENGINE ROOM OF THE INDIANAPOLIS AND CINCINNATI TRACTION COMPANY.

At the time this plant was constructed, it was regarded by many engineers as experimental, but it proved to be a very economical and satisfactory way to produce and transmit current. The Union Traction lines are recognized as the most successful heretofore in operation in the United States.

In the building and equipment of the Union Traction lines Mr. Henry secured the services of Messrs. Sargent & Lundy, Chicago, who occupy the front rank among electrical and mechanical engineers, and when he undertook, on the part of the Indianapolis and Cincinnati Traction Co., the construction of its lines, he again secured their services, and under their advice and supervision this line is being constructed and equipped on still more modern methods, eliminating much that was formerly thought necessary, and using alternating current motors on the cars.

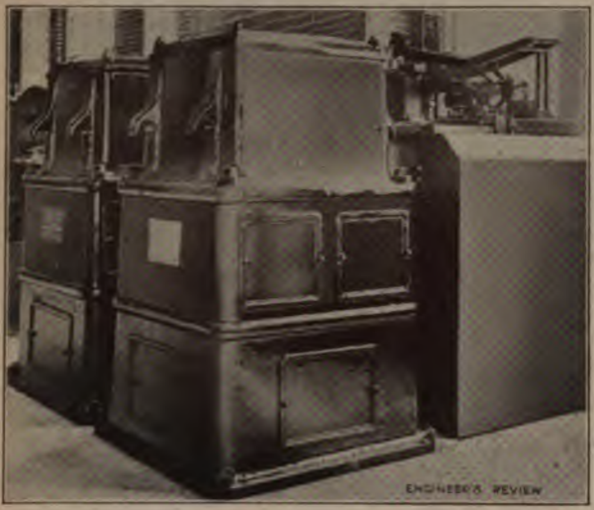


FIG. 3. ELECTRICALLY OPERATED CIRCUIT BREAKERS.

The company has secured a most desirable site for its power station and car shops at Rushville, 40 miles from Indianapolis, and as the electric current can be transmitted 90 miles in any direction with very little loss, no other power station will be needed for a very large system.

The site is adjacent to the C. H. & D. Ry., with a connecting track from that road to the company's side track along side the power station, which track in turn connects with the company's main track. This track arrangement is convenient for ordinary business, but especially so whenever coal shall be used as fuel, providing it is required due to lack of gas, for with it the company can deliver coal from its own line or take it from the C. H. & D. Ry., shifting the cars with its own power. The side track along the power station is built at a proper elevation for dumping and crushing the coal so it can be handled by carrier and elevator and fed under the boilers on chain grates without being handled by man power.

Along the east side of the power station site runs a mill race from the stream known as "Flat Rock" and the company has a perpetual contract with the owner of the mill race for the use of the water for condensing and other purposes.

The power station building is 113 feet by 128 feet 10 inches, of very heavy and substantial construction. The foundations are all concrete and the upper walls are of brick laid with cement mortar. All of the floors and other frame work and roof structure are of steel. The floors are concrete and the gravel-asphalt roof is laid upon a concrete base with expanded metal, leaving nothing about the building that could burn except the doors and windows. The building is planned and built with a view to the installation of coal crushing and automatic coal handling machinery, with overhead bunkers feeding direct to the boiler grates. As the company has natural gas for fuel at present, these bunkers and carriers have not been installed, but everything is prepared for them, even to the punching of holes in the steel structure for the rivets to suspend the coal bunkers.

The foundations for the engines, boilers, pumps and other machinery are all solid concrete, and all stairways are either steel or concrete. The galleries and chambers for the electric wires, cables, switches, etc., are built according to the most modern plans and in the most substantial manner so as to avoid trouble from fire or jumping of electric current. The entire building is constructed according to the latest and most approved designs prepared by the engineers, Messrs. Sargent & Lundy, who have taken extraordinary interest in it because of the fact that it is to be the first road using alternating current throughout.

A concrete tunnel or pipe 3 feet 6 inches in diameter, provided with carefully screened grates, carries the water from the race way under the basement floor of the power station for use in the condenser pumps, and a like constructed tunnel is provided for carrying the same back into the mill race some 300 feet below the intake.

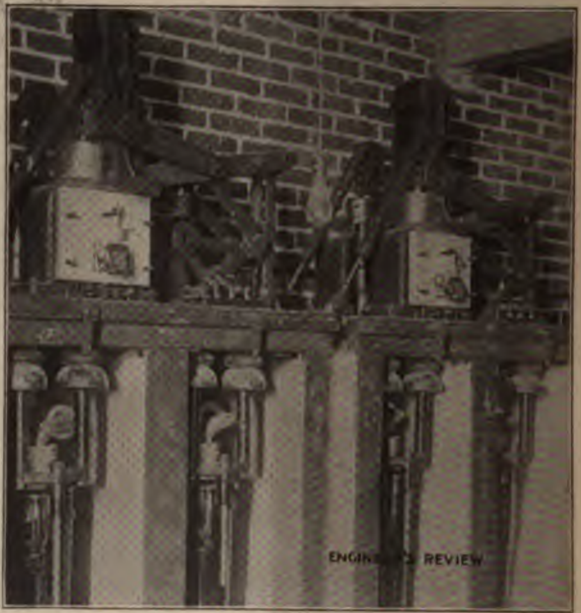
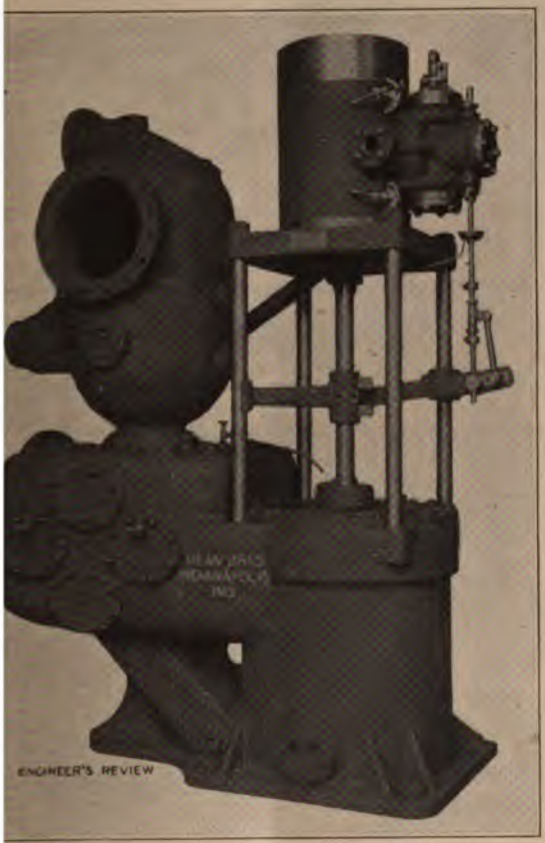


FIG. 2. 250 KILOWATT AIR BLAST TRANSFORMER AND OIL SWITCH.

At the east end of the power station, built upon a heavy concrete base, is a self-supporting steel stack, 180 feet high, lined its entire height with fire brick, 11 feet inside measurement, of sufficient size to take care of eight 350 horsepower boilers, for which space is provided in the present building.

The power station is so framed and constructed that the west wall can be taken out without disturbing the other walls or the present steel frame work,

building can be extended to the west, where
of over 200 feet is reserved for extensions to
date future needs of the company.
present power station equipment consists of
orliss type cross-compound condensing, 700
wer engines as shown in Fig.1,which were built
Fulton Iron works, of St. Louis, Mo. Mounted
e shaft of each of these engines is a 500-kilo-
rmal capacity, with 50 per cent overload guar-
irect connected generator. Additional unoccu-
ace is provided for two more power units, in-
to be two generators each of 1,000 kilowatt
capacity and 4,500 kilowatt maximum capacity,
he machines being guaranteed for 50 per cent
d. These engines have cylinders 20 and 40
in diameter by 48-inch stroke running 94 revo-
per minute with 150 pounds steam pressure.



TYPE OF DEAN AIR PUMP AND JET CONDENSER USED.

machines develop a three-phase current at 2,300
This current is stepped up by two 250 kilowatt
connected transformers of 33,000 volt quarter-
current, and is transmitted to the transformer
s single-phase at 33,000 volts. The step up
rmers shown in Fig. 2 are of the air blast type,
cooling these transformers being furnished by
-inch fans driven by three-phase induction mo-
To insure the station from a possible shut-down
failure of an exciter unit, two units are pro-
one being a 50-kilowatt steam driven set, and
her a 50 kilowatt induction motor driven set.
itches for 33,000 volts are installed between the
p transformers and the 33,000 volt quarter-phase
bus bars, one being shown in the upper right hand corner of Fig. 2. On each of the outgoing lines to the transformer stations a single pole 33,000 volt automatic switch is provided, thus giving complete control of each of the transformer stations from the switch board in the power house. The oil switches, disconnecting switches and switchboard appliances comprise the latest developments in this type of apparatus. The electrically operated circuit breakers are shown in Fig. 3.

Each engine is equipped with an independent jet condenser, which as well as all other pumps about the station were built by the Dean Bros. Steam Pump Works, of Indianapolis.

The jet condensers are in duplicate. They are of the vertical, single style, (Uniplex), double-acting, brass fitted, air pumps and jet condensers, size 14 x 30 x 18-inch, as shown in Fig. 4.

The boiler feed pumps are in duplicate, and are of the vertical, single style, (Uniplex), double-acting, brass fitted, piston, "Atlantic" type pumps, size 14 x 10 x 24-inch.

The low service pump is one of the horizontal, single style, (Uniplex), double-acting, brass fitted pumps, size 10 x 10 x 20-inch.

The engine room is provided with a traveling crane built by the Northern Engineering Works, of Milwaukee,. Wis., of sufficient capacity to handle all of the machinery.

The boiler room runs the entire length of the building. At the present time three Babcock & Wilcox water tube boilers of 350 horsepower normal capacity, each with superheaters, have been installed, under which natural gas is burned under a contract whereby the company secures the same at 10 cents per 1,000 cubic feet. Additional space is provided in the building for five more boilers of the same capacity, which will be installed as rapidly as additional power is required. An end view of the engine and boiler room is shown in Fig. 5.

An open water heater built by the Stilwell-Bierce & Smith-Vaile Co. is installed in the boiler room.

Exhaust steam is used from the engines to heat the power house itself as well as the car shops located near by on the same tract of land, thus utilizing what would otherwise be a waste. All of the piping for the power station and for heating the car shops has been furnished and erected by the Pittsburg Piping & Equipment Co.

From the lighting plant in the power station, light is furnished to the car shops and also to the company's office building some four squares away.

The road is divided into sections of 10 or 12 miles, each of which is supplied with electric current from a transformer station. Three such stations between Indianapolis and Rushville have been erected by Pulse & Porter, contractors of Greensburg, Ind. These buildings are very small, only 21 x 23 feet, but are carefully and substantially built. The foundations are concrete; the walls are brick and laid in cement mortar; the floors, both for the first and second stories, are concrete upon steel beams, and the roof is laid upon a concrete base built on expanded metal. The doors and windows are provided with steel shutters and the whole structure is made so as to be fire proof and can be closed and left alone with safety.

In each of the transformer stations are installed two 300 kilowatt oil insulated step down transformers.

there being sufficient room for an additional transformer of the same capacity. On the second floor of each transformer station are lighting arrestors. There are no automatic switches of any type in these stations, as they are controlled entirely from the switchboard in the power station, and there is nothing about the station which requires constant attention and only occasional inspection will be necessary. This does away entirely with the expense usually incident to a sub-station under any other system, which amounts to the wages of three men at each sub-station, aggregating no less than $6 per day, thus making an annual saving of $6,570 on three transformer stations between Indianapolis and Rushville; or a total annual saving of $21,900 in wages at the 10 transformer stations required between Indianapolis and Cincinnati; and in addition to this a large amount is saved in maintenance and repairs of machinery.

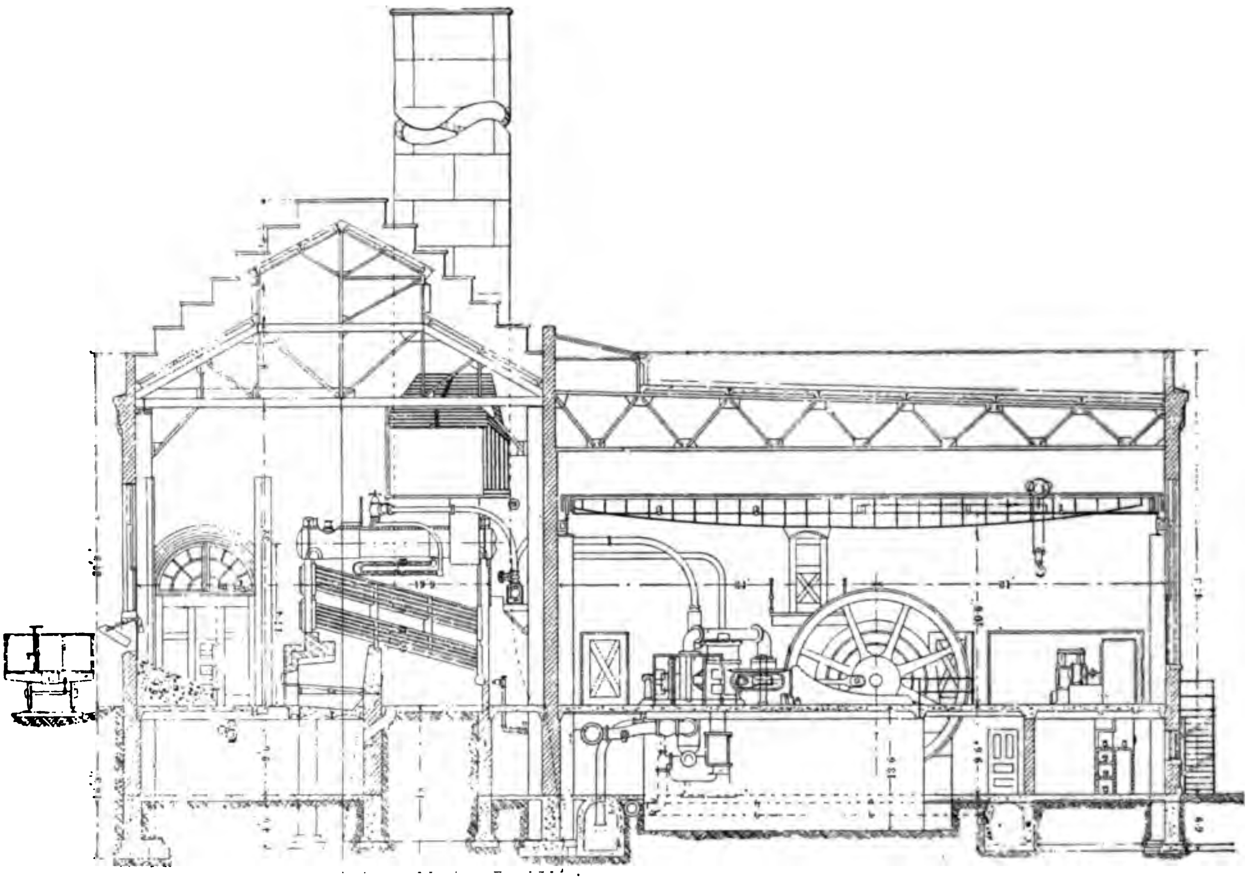


FIG. 5. PLAN VIEW OF THE BOILER AND ENGINE ROOM.

The motor equipment consists of four 75 horsepower single-phase alternating current motors. Train control of the electro-pneumatic type is installed on each of the cars enabling one motorman to control the operation of a train of any number of cars. The motors operate on alternating current at a voltage of 250, this voltage being derived from an auto-transformer mounted under the car, this transformer deriving its voltage from the 3,300-volt trolley. Both straight and automatic air brakes are provided on each car, the straight air brake equipment being used when only single cars are operated, and automatic air brakes being used when the cars are operated in trains. The motors on the present car equipments are geared for a maximum speed of 45 miles per hour for local service. The motors are all connected in parallel so that any one of them may be cut out of service if it becomes damaged in any way. The motor and control equipments are so designed that they may be operated on direct or alternating current and the necessary switches for making the changes and connections are provided underneath the cars. By this provision the cars run equally well on a 500-volt direct current. Each of the cars is provided with two trolleys. One is an ordinary wheel trolley for use in running over the Indianapolis city lines, and the other is a sliding contact or "bow" type trolley, held in position by compressed air, to be used on the lines of the company especially with a view of taking from the trolley wire sufficient current to attain high speed and carry heavy loads. This will, however, be more important in the equipment of cars for "limited" service, and for heavy loads of freight.

The "limited" cars for through service will be like the present cars except that they will be equipped with four 150 horsepower motors and geared to a maximum speed of at least 80 miles an hour. Such cars cannot be operated successfully from a low voltage trolley wire or with the common wheel trolley. It is also confidently believed that with the high voltage alternating current trolley wire and sliding contact trolley adopted by this company, heavy freight can be hauled advantageously without experiencing the dif-

---

The plan view is reproduced from the *Electrical Review*.

es heretofore encountered in the use of direct nt on low voltage trolley wires.

e Westinghouse Electric & Manufacturing Co. supplied all of the electrical equipment for the r station, the transformer stations and the cars. have also supplied the brackets, trolley insulators angers and other special material for the trolley ruction; all of which has been made according ecial designs furnished by Sargent & Lundy.

ENGINE ROOM CHATS NO. 21.

BY A. GOVERNOR.

e next noon the engineers had hardly settled before the subject of engines was taken up again the same interest with which it had been dis- d the day before.

ay, Dave, what was you going to say about Corliss es yesterday," asked Bill Ross.

was just agoin' to say that high speed engines 't the only kind of engines that gives trouble. Of e you know that the valves of a Corliss engine ate on the valve seats, and that some of them disks on the back end of the valve, which are ed by set screws through the valve seat cap, to up any end play there may be in the valve.

good many fellows don't know that, but it is this that makes a lot of bother, because it gets to king pretty often. Usually the engineer says the e ain't getting enough oil to do the work. The ces are, that the set screw has been set up so that there ain't any thing else to do but squeak. ow I set um up so hard once, that the friction was gh to overcome the vacuum pots, and the valves y staid open until the hooks closed them.

here are different ways of taking up the end play e valves. When an engine ain't equipped with et screws, the ends of the valves are backed up a circular liner, which is very thin and springy, he valve covers have to be pressed on pretty hard rder to get them in place. I have noticed that give a lot of trouble from squeaking, and the unt of oil that is fed don't seem to make much rence. When you take the squeaking of the s, mixed together with tight packing on the valve s, as I have seen before now, and badly adjusted pots valves, it is enough to make a new man with engines wonder how they ever became so pop- "

never had much trouble with Corliss engines," Sam as Dave showed no signs of going on with emarks. "The most trouble I have had is from of lubrication of the low pressure cylinder of pound condensing engines. I have usually found ble from this cause, when the engine had an ir- lar load, which would cause the low pressure cyl- r to have very little steam for a considerable length me.

mperfect lubrication will be found in cases when ngine is running light, because there is so little n being admitted to the high pressure cylinder, it has lost its expansive force before it reaches the pressure cylinder. This leaves a partial vacuum e latter, and of course no steam enters it from the pressure cylinder, practically speaking. In such se, the low pressure cylinder receives little benefit from the oil that has been fed into the high pressure cylinder.

"The way I get over the difficulty," continued Sam, "is to attach the lubricator directly to the low pressure cylinder, so that it will feed oil directly into it and independently of the high pressure cylinder. Some engineers pipe the lubricator steam connection to the receiver, but I never had good success that way, because I find that although the lubricator on the low pressure cylinder will feed all right for a short time after starting, it will not be long before it will cease to feed, if it is not watched, and the noise in the cylinder soon makes the fact known.

"A better way is to connect the lubricator steam pipe to the high pressure pipes, and then when the lubricator is set working, I know it is going to keep at it until I shut it off. When the lubricator is connected to the low pressure cylinder, you can see that the oil enters in drops and spreads on the cylinder surface, a good deal as oil will spread on a metal surface heated to the temperature a cylinder would be, while the engine was in operation."

"Wall now, you fellers have had your say as to what an engine wants," interrupted Steve Brown, as he wiped his mouth with the back of his hand, "but ther's one thing that you ain't hit on yit, and that is the thing what the oil is fed from. Now I want you fellers to know, that the lubricator has just a little mite to do with the iling of an engine, and no mistake about it. I kin remember the time when we had to use a hand pump to ile ther cylinder; some of the old codgers still hang to um now, up in some of the way back places. You can just bet your whiskers, if yer can find any, that them were the times when a feller had to get along as well as he could, and trust to luck that the engine cylinder was gettin' enough ile. I've seen some funny lubricators in my day and no mistake. In my judgment the up fed is the best thing in the shape of a lubricator that is on tap, although the force feed lubricator is a mighty good thing in its way, and between ther two I can't say that I've got much choice."

"I guess the most of lubricator troubles are found in the piping of the condenser pipe," said Sam as Steve leaned back against the wall of the fire room. "More than one lubricator has been condemned by engineers simply because there was not enough weight or head of water above the oil to make it operate as it should. Another fault with a good many lubricators is because there is no possible way in which to tell the height of the oil in the reservoir."

"What is your explanation of most of the lubricator troubles that a fellow is likely to run up against in ordinary practice?" asked Bill Ross as he shied a piece of coal at the cat.

"One difficulty," replied Sam, "is what is known as churning and it is quite common. This is when the oil and steam become mixed and the oil refuses to feed. It is generally brought about by trying to start the lubricator too soon after filling, and before sufficient condensation has taken place.

"Pulsation in a lubricator is another source of trouble and is usually caused by the steam pipe to the engine being too small. If it is a double connected cup, however, the trouble may be because the condensation pipe is too short. If this is what is the matter, all that is required is to lengthen the pipe, or put in a few more coils. If the cup is single connected with the pipe running from the support arm to the top of the condenser, the trouble can often be stopped by lengthening the pipe. Quite often lubricators will not feed when apparently in good order, because too heavy oil is used, and the weight of condensation above the reservoir is not enough. When this occurs, the pipe should be lengthened in order to get a greater head."

"What about oil sticking to the sight feed glass?" asked young Ross, as he threw another piece of coal at the cat which had recklessly poked his head around the corner of the boiler setting.

"Luck here me b'y," interrupted Dan, "there's an ould sayin' that some people rather thin climb ther golden shtairs ter hiven, foind it a dale aisier ter slide down ther banister ter ther other place, and Oim just tellin'yer thot ye'll have a chanst ter take yer choice fur aither place, if yer don't lave that tom coat alone, do yer moind?"

"I thought everybody knew about that," volunteered Dave Hill, as Dan subsided from his defense of the cat, "but I will give you a tip, Billy, that you don't have much trouble with that sort of thing if there is plenty of water in the condensing pipe to feed the oil. When you haven't got enough condensing water then's the time you get your trouble with stuck-up sight glasses. Another reason is because a fellow is too blamed lazy to get up and fill his lubricator before it runs empty, and everybody that has ever run a lubricator knows that the last few drops of oil spread out like a woman's Easter bonnet, and stcik to the glass."

"I've found that keeping the sight glass filled with glycerine will prevent oil from sticking, and is about as good as anything else," observed Pete Haynes, "but there's one thing you haven't hit on yet, and that is lubricators stop feeding some time. I think, however, this is more the engineer's fault that anybody else's."

"How in the dickens do you make that out," asked Bill Ross, with his eyes still on the cat which was in hiding behind Dan Googan's chair.

"I make it out just this way," was the reply. "You know as well as I, that most engineers keep a supply of cylinder oil in an old coffee pot, or a new coffee pot if they have the price, and keep it on the steam chest of their engine or some other hot place. You can bet your bottom dollar it never stayed on my steam chest though. Of course the oil gets warm and is put in the lubricator warm and when the lubricator starts to feed the oil is warm, but after a while the temperature falls to that of the engine room and the lubricator stops feeding, and has to be set again to get the right number of drops. The same trouble is brought about by allowing cold air to blow through the engine room chilling the lubricator, and causing it to stop feeding, because the temperature of the oil is low."

"I have seen more than one engineer change cylinder oils because he wasn't getting satisfactory results from his lubricator," remarked Sam, "and then they were not satisfied. If they had been using a thin oil and and got a heavier oil, the cup would feed slower. The first thing they think of is that the opening in the point of the feed valve is too small to let the oil pass out freely, and they at once proceed to enlarge the same, but as I have already said, the pressure required to force the oil through the nozzle is supplied by the weight of condensation and if the area of the feed valve is increased or decreased the proportion to the other parts of the cup is altered and it will not feed satisfactorily. The thing to do is to increase the weight of condensation." After considerable more discussion upon the subject the engineers departed to their respective plants.

A few days later Sam notified Mr. Winters that he had an offer as chief engineer of a large concern. The salary was so much more than Sam had been getting that Mr. Winters could not hold out any inducement in the way of an increase in salary, although he did the best he could. After another engineer had been secured Sam departed to his new field of labor with best wishes for success from all of his associates.

The new engineer did not take to the noon-day meetings, and soon one after another stayed away, until only Dan and the cat were left occupants of the fire room, and the profitable engine room chats became a thing of the past.

INDICATOR PRACTICE.

MEASURING DIAGRAMS BY ORDINATES.

BY W. H. VINCENT.

After taking an indicator diagram, the next step is to figure out the mean effective pressure, for without this the horsepower of the engine cannot be ascertained accurately. Mean effective pressure is the average pressure on the piston during the stroke, or the pressure which, if allowed to act upon the piston through the entire stroke, would do the same amount of work as the steam pressure if cutoff and expanded down, as indicated by the diagram which is to be measured.

In order to find the mean effective pressure, the average height of the diagram must be known. To ascertain this, the diagram is divided into ten equal parts by means of nine dotted lines, as shown in Fig. 1. The ten heavy lines drawn in the middle of these divisions, are called ordinates.

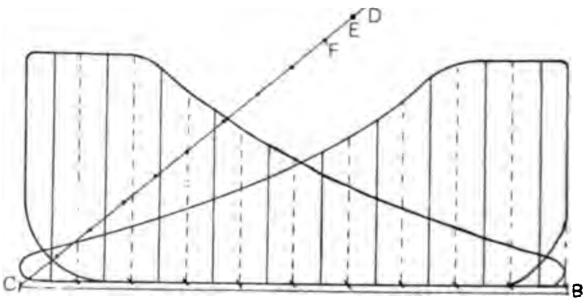


FIG. 1. METHOD OF DRAWING ORDINATES.

When ready to begin the calculation, divide the diagram into nine divisions as shown by the dotted lines. This is accomplished by drawing a line perpendicular to the atmospheric line *C B*. From the point of intersection draw a line *C D*, at any convenient angle, and space off ten points, as shown. Then with two triangles, or a triangle and a rule, placed in such a position that the edge of the triangle just comes to the point *E*, and the end of the line *B*, draw a light line with a sharp pointed pencil across the line *C B*. Then slide the triangle on the rule until the edge just comes to the point *F*. Then draw the next line across the atmospheric line *C B*, and so on until the diagram has been divided into ten spaces.

Next draw the heavy lines shown midway between the dotted lines perpendicular to the line *C B*, through the intersecting points. The diagram is then ready for measuring. It should be understood that the more lines the diagram is divided into, the more accurate will be the result. For this reason many prefer to draw in 20 ordinate lines rather than ten.

The most simple, and at the same time the most accurate and quickest way of measuring the length of the ordinate lines is to take a strip of paper and with the end even with the bottom of the diagram, but not on the atmospheric line, begin at the steam end of one of the diagrams and measure the ordinates of that card by placing the paper on the line and marking on it the length of the line. Then place it upon the next ordinate, with the mark on the paper even with the bottom of the next ordinate and so on, until all of the ordinates have been measured. Then, with a scale, measure the combined length of the paper which will be the distance from the edge of the paper to the last mark. The final measurements should be made in inches and hundredths of inches. The total length, multiplied by the spring and divided by the number of ordinates, gives the mean effective pressure.

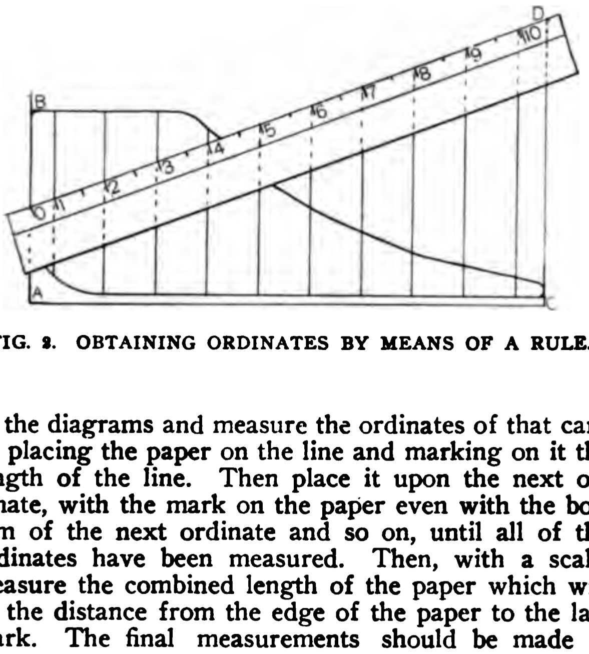


FIG. 2. OBTAINING ORDINATES BY MEANS OF A RULE.

Another way of dividing a diagram into ordinates, is shown in Fig. 2. With this method, take a rule a little longer than the ordinary length of the diagram, divided just as the diagram is desired to be divided, either with 10 or 20 ordinates equally spaced, but with the two end spaces of one-half the width of the others. As 4 inches is about the length of indicator cards, a rule 4 inches between the zero mark and the outer end is a good length. Other rules of from 3½ to 4½ inches in length may be used for cards longer than 4 inches. If the diagrams are less than 3½ inches in length shorter rules may be used with them. Such a set of rules do not cost much and will cover all ordinary cases coming up.

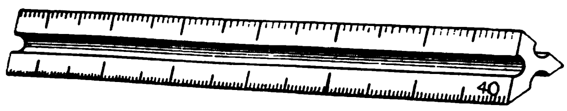


FIG. 3. ENGINEERS RULE.

In dividing the diagram into ordinates first draw the lines *A, B* and *C, D,* at the extreme ends of the diagram, perpendicular to the atmospheric line. Then place the rule between them as shown in Fig 2, so that both the zero and the half space beyond 10 comes exactly upon the perpendicular lines *A, B* and *C, D.* Then with a pin point or some other sharp point prick exactly opposite each division of the rule and draw the ordinates through these points and perpendicular to the atmospheric line *A C.*

Another way is to obtain an engineer's scale as shown in Fig. 3. It is shaped like the scale used for measuring diagrams, which comes with the indicating set and has six scales, but instead of being divided into feet and inches in the various proportions of the ordinary draftsman's scale, it is divided into 10ths, 20ths, 30ths, 40ths, etc., of an inch which allows it to be used in measuring diagrams taken with the corresponding scale. Such scales can be obtained in any suitable length from dealers in such materials.

If the diagram is exactly 4 inches long the scale marked 50 will be found to divide the diagram into exactly 10 equal parts, or if desired into 20 equal parts, by laying the scale on a line parallel to the atmospheric line. If, however, the diagram is of less length than 4 inches, the scale should be inclined as shown in Fig. 4, so that the zero is on one perpendicular line, and the 20 mark on the other. It will be found that the figured divisions will divide the diagram into 10 spaces which are subdivided into ordinate lines by moving the scale so the center division between zero and No. 2 comes on the perpendicular line as shown in Fig. 4. By this method the half spaces are obtained on each end as shown. The ordinate lines are made by pricking with a pin or with some other sharp pointed instrument, opposite each division numbered on the scale, and drawing the ordinate lines perpendicular to the atmospheric line, the lines passing through the pin marks. It will be found that by using the different scales the various sized cards can be divided into equal divisions.

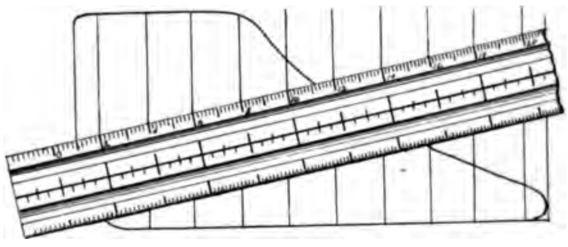


FIG. 4. SCALE USED IN AN INCLINED POSITION.

Another method of dividing a diagram into ordinate lines is as follows: Draw a line at any convenient angle to the atmospheric line at one end. Then take a strip of paper and applying a rule to the strip, mark off 10 equal spaces, which together will exceed the length of the given line. Then place one end of the strip at the open end of the given line, and carry the other end of the strip up until the last point marked off on it touches the right-angle line, and through the points on the strips draw lines parallel with the right-angle line; the given line will then be divided as required, as shown in Fig. 5.

To illustrate, let the line *A C* be the given line or the atmospheric line; then draw the line *C B* at right angles to it as shown. The first 10 equal spaces on the rule will exceed the length of *A B,* and will be ten,

¼ inches; mark these ¼ inches off on the strip of paper; place the end of the strip to the end *A*, of the line *A C*, and move up the strip until *B* touches *C B;* then through the points on the strip draw the lines or ordinates 1, 2, 3, 4, 5, 6, 7, 8 and 9 parallel with *C B*. The line will be found to be divided into ten equal spaces, which are divided again and the lines last drawn are the ones to be measured.

To those who do not have a planimeter and who are desirous of computing the horsepower of their engines from indicator diagrams, either of the above methods will be found advantageous. In the latter method of dividing a line into ordinates, if the lengths of the ordinates are desired they can be measured as already stated.

Another method of obtaining the area and mean effective pressure is by means of an instrument known as the planimeter, the working of which will be detailed later.

We now know how to find the mean effective pressure, but in order to find the horsepower which an engine is developing, as indicated by any particular card, we must find the engine constant.

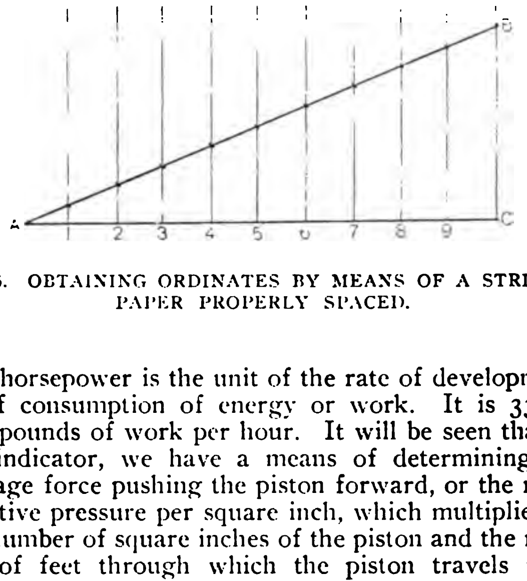


FIG. 5. OBTAINING ORDINATES BY MEANS OF A STRIP OF PAPER PROPERLY SPACED.

A horsepower is the unit of the rate of development, or of consumption of energy or work. It is 33,000 foot-pounds of work per hour. It will be seen that by the indicator, we have a means of determining the average force pushing the piston forward, or the mean effective pressure per square inch, which multiplied by the number of square inches of the piston and the number of feet through which the piston travels in a minute, and divided by 33,000, will give the horsepower which the engine is developing. After the constant has been figured, the formula for finding the horsepower of an engine is reduced to the following: $M.\ E.\ P. \times C$. In this, *M. E. P.* equals the mean effective pressure and *C* equals the engine constant. The engine constant is found as follows: area of piston multiplied by piston speed in feet, divided by 33,000.

For instance if the engine cylinder were 14×36 inches, and the speed 100 revolutions a minute, we should first ascertain the area of the piston in square inches. This is done by multiplying the diameter of the piston by .7854, or $14 \times 14 \times .7854 = 153.938$, area of the piston. This multiplied by the speed of the piston in feet and divided by 33,000, equals the engine constant or the horsepower developed by one pound of mean effective pressure. We have a stroke of 36 inches, and as there are two strokes of the engine for each revolution the piston stroke will be 36×2, or 72 inches, or 6 feet. This multiplied by the revolutions a minute equals the speed of the piston which is $6 \times 100 = 600$ feet a minute. To work out the formula, $153.938 \times 600 = 92{,}362.8$. $92{,}362.8 \div 33{,}000 = 2.798$, the engine constant. Having the engine constant the horsepower is found by multiplying the mean effective pressure by the constant. Supposing the constant to be as figured above and the mean effective pressure were 40 pounds, the horsepower of the engine would be $40 \times 2.798 = 111.92$ horsepower.

It will be seen that by figuring out the engine constant no matter how many cards are taken from it, all the calculation necessary after the mean effective pressure is obtained is to multiply it by the constant, thus saving considerable time.

In the case of an engine which will not be indicated by the same party again or where the indications are not made frequently, another way may be used, but it has no advantage over the method already explained. The second method is as follows: find the area of the piston and multiply it by the mean effective pressure and the result by the speed of the piston in feet per minute. This result divided by 33,000 equals the horsepower of the engine.

For a rough estimate, when no other means are at hand, the mean effective pressure is figured as one-half the boiler pressure, but for accurate results the indicator should be used.

ANOTHER BOILER EXPLOSION.

By Geo. P. Thomas.

On Monday morning, July 24, a small upright boiler in the plant of the Norwich Silk Co., of Norwich. Connecticut, exploded with great violence, killing the engineer and injuring two girls.

The plant was started at 6:30 a. m. as usual and had run just 23 minutes, when the boiler exploded shooting straight up in the air for more than 100 feet, tearing away the side walls and roof of the engine house, coming down through the roof of the main building, wrecking several spooling machines.

The engineer was so badly scalded that he lived only a few minutes; two girls were badly burned and one was injured by flying splinters. Most of the employees are girls and several had very narrow escapes.

The boiler was rated at 35 horsepower and was probably between 15 and 16 years old, having been used only three months in this building. It was tested on March 21, by the State Inspector, who said it stood a cold water pressure of 135 pounds, without showing any weakness and he allowed them to carry 85 pounds pressure. As near as can be learned, there was a pressure of 60 pounds on the boiler when it exploded.

The engineer, Joseph E. Hopkins, had just sliced his fire and hung up his bar and was just about to close the furnace door when a piece of plate in the firebox, about 2 feet by 38 inches tore away from the stay bolts and the rush of steam sent the boiler like a sky-rocket into the air.

The engineer was found unconcious in the corner of the engine room where he had been blown, and so badly scalded that he died on the way to the hospital.

There were 23 girls working within a radius of 75 feet of the boiler and their looms and spooling machines were smashed in front of them, but only two were injured, which, from the appearance of the building afterwards, is considered nothing short of miraculous.

REPRESENTATIVE MEN FROM THE ENGINE ROOM, 24th—George W. Poss.

The representative man we present this month is George W. Poss, chief engineer and master mechanic of the Egyptian Cotton Mills, Cairo, Egypt. Mr. Poss has had a varied experience as an egineer, having worked in the Waterous Engine Works, Brantford, Canada, going from there to the Erie Railway shop in Hornellsville, N. Y., and later on being employed in the Sinnamahoning Valley Railroad shop located at Austin, Pa. Next he was employed in the Buffalo and Susquehanna railway shops at Galeton, Pa., going later to the electrical engineering shop of the Union Iron Works, San Francisco, Cal., and later to the Mare Island navy yard. He was then employed by the Vallejo and British India Steam Ship Co., Calcutta, India.

GEO. W. POSS.

Not only has Mr. Poss been employed as a stationary engineer, but he has had considerable experience in marine engineering, having run between San Francisco, Cal., and Sidney, Australia, on steamships of the Oceanic Steamship Co. He has also been employed by the Chinese Commercial Co., running between San Francisco, Japan and China, and served one term of enlistment in the U. S. navy, during which time he was stationed on the gunboats Yorktown, Princeton and Boston. Although Mr. Poss is located in a distant land, he is a constant reader of the Review.

To protect iron and steel tools from rusting a mixture of equal parts of white wax and turpentine is made. Both substances are heated carefully to avoid firing of the inflammable turpentine until a uniform mixture obtains. The article to be protected is then rubbed with this mixture by means of a piece of cotton cloth, and the rubbing continued until a thorough covering is produced. The liquid tends to fill the pores of the iron. The further rubbing down of the mixture will produce the appearance of a polish.

27,222 cubic feet of steam weigh 1 pound; 13,817 cubic feet of air weigh 1 pound.

THE IDEA·EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

To Our Readers.

Frequently our correspondents send in accounts of flywheel and boiler explosions which have occurred in their vicinity, but usually without photographs of the wreck. We encourage articles of this nature, but request that an effort be made on the part of the writer to obtain photographs if possible. We will pay for the extra expense entailed in securing them, besides paying for the data.—Editor.

Automatic Stokers.

Editor of the Engineers' Review:

I have been very much interested in the different letters relating to automatic stokers, which have appeared in the Review of late and it does not seem at all strange that engineers should differ on this question any more than they do on all other questions relating to steam engineering. Probably never in the history of steam engineering have there been so many different types of automatic stokers on the market as at the present time, and there are few devices around a steam plant over which there is any more controversy.

We have figures galore showing the saving of the stokers over the method of hand firing, and they are given by engineers who are high up in the engineering profession, and are men of vast experience, but we see them giving up the old way, and put in the stoker. After an extended trial they come out and declare to the engineering fraternity that by their use they have effected a great saving. It is from these reports that we of the smaller fry get the idea that we must have stokers in our plant, or we will be a back number as far as economy is concerned.

Then again we see where plants have been built and they do not think of putting in stokers at all. In the New York Interborough station we have a case of this, and it is acknowledged to be the largest plant in the world, or will be when all the apparatus gets to working.

In other plants we see stokers installed, but after a time they are discarded and the old way of hand firing is again taken up. The latter test is made under the supervision of equally as well trained men as the others but they can give figures to show that there is a saving of so many pounds every month.

Such instances are suggestive, and we begin to wonder where we are at. It isn't reasonable to believe that prejudice has anything to do with the difference in the way stokers operate in different plants or with different engineers. Those who stand up for the stoker not only believe in them, but as has already been said, have facts and figures to back them up in what they say. On the other hand, those who have no use for them, are just as well fortified in the same kind of material and therefore, have a perfect right to their way of thinking. In fact the data of one is just as convincing as the other.

It is the easiest thing in the world for the man who believes there is nothing like the automatic stoker, to think the man who doesn't like it is either not honest in his opinions or that he is not an intelligent thinker.

It will be found that if a given machine fails, engineers will argue that it is the machine and not the system which is at fault. We learned long ago that because Mr. Smith's apparatus does not give satisfaction there is no reason why Mr. Johnson's should not be given a trial. As far as my knowledge goes we have found that it is not any particular type of stoker which has failed, or succeeded. We have them divided into what might be termed two classes, the over-feed and the under-feed. Each one has good points distinctly its own, but just the same, each type has been rejected by some and lauded to the skies by others.

The fact that engineers hold different views on this subject, each based on facts as shown by their figures and experiments, leads one to inquire as to the reason.

It would appear to me that the success or failure of the automatic stoker, is due to the conditions under which it is used. Now we all know that there are kinds of coal that cannot be automatically fired in such a way that they will keep up steam, while it is quite possible that with a different kind of coal the trouble would disappear.

From my experience with automatic stokers, I believe their principal defect is lack of flexibility, and that they depend for their success on plenty of boiler power and steady use.

Another question that comes up is that of forcing stokers. One set of engineers will maintain that the stoker cannot be forced, while another emphatically states that it can. I believe that both are at the same time right and wrong. If a stoker is so designed that it will provide for the evaporation of 8,000 or 10,000 pounds of water per hour, and then an attempt is made to run the evaporation to 13,000 or 15,000 pounds the result will undoubtedly be a failure.

We all know that to burn coal at various rates on the same grates at irregular intervals, requires intelligence, and we all know that automatic stokers are not blessed with this requirement. As a general thing they always depend on the principle of carrying the fresh coal in at the fire door where it is conveyed or pushed along to the bridge wall end of the grate.

By the time it gets to the bridge wall it is supposed to be all burned, but it is next to impossible to keep the grates evenly covered by a machine, when there is a variation in the demand for steam. With hand firing, a skillful fireman will not allow holes to burn through his fires, as he will always place a shovel full of coal just where it is wanted, but no machine can do this, although many schemes have been tried. There are many cases where the automatic stoker is better adapted than other methods of firing.

We all know of hundreds of plants when we stop to think of them, where no special intelligence on the part of the fireman is required, because the demand for steam is steady and continuous from morning until night, therefore, the same amount of water is evaporated each working day. In the cotton mills of the East and public stations in large cities there is usually plenty of boiler power, the load is steady, and no sudden demand is ever made on the boilers. Such conditions are perfectly suited to the automatic stoker.

When we have such conditions as these and our stoker is say, of the chain grate type, we have an opportunity of placing a thin layer of coal, which is spread evenly over the grate and is slowly advanced into the furnace. After the load on the boilers is known it is an easy matter to adjust the supply of coal on the grate and the air supply below, and the rate of feeding the grate, that the combustion of the coal will have been just completed by the time it reaches the bridge wall. Thus it will be seen that with a steady load, the stoker makes an ideal addition to the steam plant. There are, however, many cases where the stoker has been installed, where it is impossible to keep these three factors in the same relation. If the draft is increased a little, holes are burned through the fires near the bridge. This is because the coal is consumed so rapidly that the ends of the grate are left bare. If the draft is reduced unburned coal is pushed over the bridge.

There is something attractive in the idea of having a plant equipped with mechanical stokers, and something repulsive in the idea of hand firing, and if automatic stokers always did what they do in a great many places now, hand firing would have long ago become a novelty. According to my opinion, in order to get success from the automatic system of firing it is necessary that there be plenty of boilers.

F. A. Crail.

Vertical Boilers.

Editor of the Engineers' Review:

One would suppose after all the experimenting by boiler manufacturers on boilers of various types that they would have a very good idea by this time as to the needs of the engineer and the man who buys the boiler. From some of the boilers we see, it is evident that this is not so.

Take for instance the upright boiler. It is one of the oldest types of boiler that we have, and yet it is not constructed as it should be, in some instances at least. This boiler consists of a shell having one head and an internal circular firebox or furnace. The ends of the tubes are expanded into the upper head of the shell, and into the top or crown sheet of the furnace.

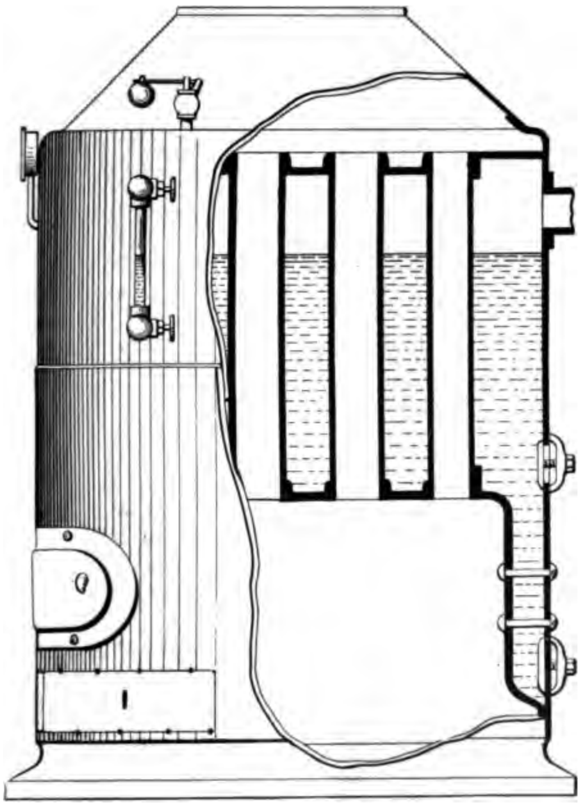
In the submerged type, the tubes are not injured by the flames from the furnace, as they are protected by the water which surrounds them at all times, unless the water is allowed to get too low, which does not occur very often. It is a boiler that is far more preferable than the type having the tubes exposed, but is used less in stationary practice. This is because the latter costs less to make, and is therefore sold cheaper than the submerged type.

A well built and a correctly designed upright boiler, when covered with a suitable covering of asbestos, is one of the best forms of boiler for small power. I recently saw an upright boiler that is about the limit for boiler making. The boiler in question is of the vertical type with the tubes exposed. It was bought to replace a larger and better boiler of the submerged type by the engineering department of a company which one would suppose would use better judgment.

As far as the design is concerned it does not speak very highly of the manufacturer's ability to make a good boiler. Fig. 1 shows the boiler as it stands, ing the work that should require a much larger iler. It will be noticed that it has a joint midway the shell, two plates having been put into the boiler. ıe rivets on this joint required calking before the iler had been in operation four months, as did also e horizontal seams.

The main objection to the boiler is the manner in ıich the steam pipe is arranged. As will be seen e pipe instead of entering the steam space at the top the boiler, is piped into the side of the shell and is least 4 inches nearer the water line than it would be the pipe had been put in at the top. Consequently e engine is working water about half of the time. If experienced hand is placed on the throttle valve, e water can be felt as it passes.

Not only is there a waste of water from the boiler, d it amounts to a good deal in a year, but there are ıer wastes. The drips of the engine are left open all times, as the cylinder would be flooded if they re not. This of course allows a good deal of steam escape without doing any work. More oil is reired to lubricate the cylinder and certainly more al is required to do the work. In fact the new boiler costing so much more for operating expenses, that e company is figuring on putting in a larger boiler the submerged tube type.



ıG. 1. UPRIGHT BOILER WITH INSUFFICIENT STEAM SPACE.

It would seem that if a boiler of the type of Fig. 1 re installed and the trouble of carrying water over o the cylinder were experienced, it might be remed in a measure, by piping the steam connections as own in Fig. 2. This could be accomplished by cutting out a hole and riveting on a reinforcement piece, and piping the two steam outlets to a steam header as shown. If this were done, it is evident that there would be less chance for the water to go over into the cylinder of the engine.

Another thing about the boiler was the ash pit door. In the first place there was no door, merely a kind of cover which the engineer placed in position when he wished to shut off the draft. When the draft was required the plate was lifted to one side, which was most inconvenient. The engineer fixed it as shown in the illustrations, where the plate is in the form of a slide and is held in place by pins. When the draft is required to be altered the plate is shoved whichever way is necessary.

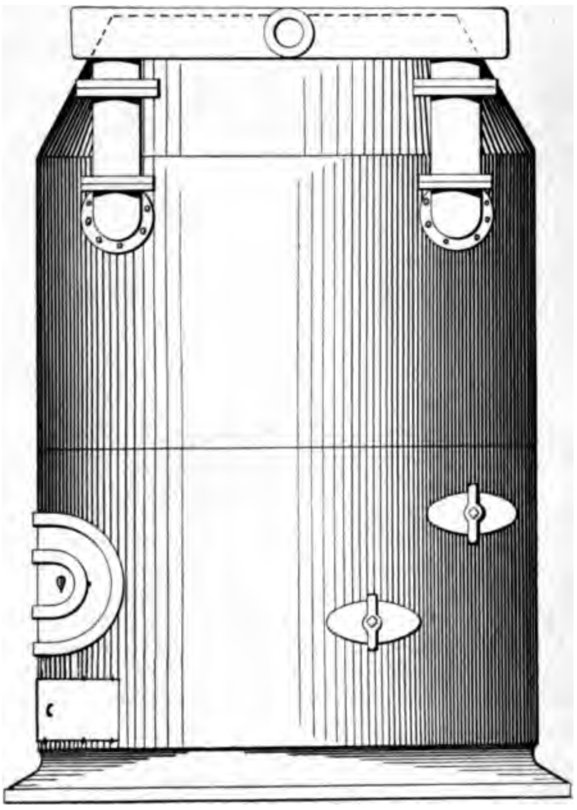


FIG. 2. SHOWING A REMEDY FOR PREVENTING CARRYING WATER OVER TO THE ENGINE.

Now the question is, why did the maker construct that boiler along such lines, when a good boiler that would have been a credit to the firm could have been made just as well?

F. S. K.

Boiler Plate.

Editor of the Engineers' Review:

I was wondering the other day as I stood in front of my boilers, as to just how much engineers really know regarding the boilers they are operating. We hear a good deal about tensile strength, double riveted joints, braces of such a size as to stand so many pounds strain, and the like, but what do we know regarding the material and construction of our boilers?

We know that boiler plate is supposed to have a tensile strength of about 55,000 to 60,000 pounds, and that it is not desirable to have a tensile strength above 65,000 pounds, as above that, the plate will be harder and less ductile. We also know that the elastic limit of boiler plate should be between 30,000 and 33,000 pounds, having an elongation of between 20 and 25 per cent; sometimes more, according to the thickness of the plate. We are told that the plate should be free from blisters, laminations and blowholes, and that the work of construction should be of the best. The point is, how much of the above do we actually know regarding the boilers, we are in such close touch with every day.

When an engineer assumes charge of a plant, he naturally gives the boiler an inspection the first chance he has. Although he may find them in good shape as far as appearance is concerned, he has no way of ascertaining anything about the workmanship put into their construction or the actual condition of the plate, as to tensile strength, elasticity, etc.

Crystalization of the plates, rivets and braces is a condition which the engineer cannot know has taken place, except as the result of an investigation after a boiler explosion has occurred, and not then, unless he has been fortunate enough to have escaped alive.

One would think that with all of the dangers attached to steam generation, that boiler manufacturers would insist upon the best of every thing for the construction of their products, but boiler makers run chances as well as others. They have the temptation to turn out imperfect work, as do others. Doubtless there are times when the flanges are turned and the plates are bent at a temperature that is liable to result in defective work. The bending of steel plates requires skilled handling, as they become brittle at a temperature corresponding to a blue heat. If work is done on steel plates at a blue temperature, cracks are liable to occur.

Then again, the holes in the plates are punched, rather than take the time to drill them. The practice of punching is not in itself so bad, if the holes are left small enough to allow for reaming out. This is something that is not always done, and the boiler is made with strictly punched holes. Punching tears the fibers and weakens the plate, and is done because it is cheaper to punch, than to drill the holes. The only way an engineer can tell, as to whether the holes have been drilled or punched, is to remove a rivet and examine the hole, which will reveal the fact at once. There are very few, however, that take the trouble to make this examination. Often the knowledge gained would not repay one for the trouble taken and it would do the engineer very little good to know anyway, as there would be but little chance in the average plant for remedying the defect.

Another matter over which the engineer has no control is that of using the drift pin in the construction of the boiler. When the plates are assembled there are times when the holes do not line up, due to error in the drilling, or punching, as the case may be. According to the advice given in our text books, the plates should be thrown to one side and cut down for smaller boilers, but the boiler maker does not see things in this light, and the plate is used and knocked into place with the aid of the drift pin. This distorts the holes and when the rivets are headed over, they cannot fill the holes as they should. Such plates will be the first to show signs of unequal strain and distress.

The rivets and the way they are put in the holes is one of the most important features in the construction of the seams. The rivets should show a tensile strength of 48,000 pounds for iron, and 55,000 for steel, and have a sufficient resiliency to be bent, when cold, around a bar of the same diameter, and bend double when hot, without breaking. Whether the rivets in the boilers we are operating come up to this standard or not is uncertain.

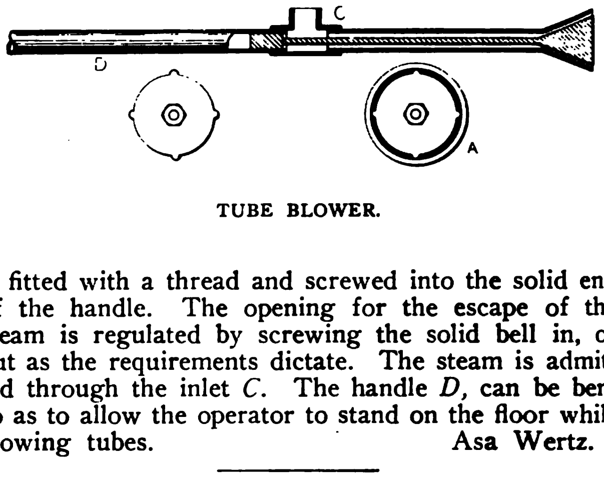
Without doubt boilers are made in a better manner now, than formerly, due perhaps to the attitude of boiler insurance companies and the state laws relating to boilers, as well as a growing tendency toward the use of higher steam pressures. When the matter is summed up however, there is very little we actually know regarding plate and construction of the boilers.

L. M. Wentzel.

Tube Blower.

Editor of the Engineers' Review:

The accompanying illustration shows a steam or air flue blower. The blower is to be made with an inner and outer bell as shown at *A*, the inner bell being solid as shown. The rod connecting the inner bell is fitted with a thread and screwed into the solid end of the handle. The opening for the escape of the steam is regulated by screwing the solid bell in, or out as the requirements dictate. The steam is admitted through the inlet *C*. The handle *D*, can be bent so as to allow the operator to stand on the floor while blowing tubes.



TUBE BLOWER.

Asa Wertz.

Boilers for High Pressure.

Editor of the Engineers' Review:

I presume your other readers were considerably interested in the account of the boiler explosion illustrated in the April issue and it was interesting to me. As far as I can gather from the article it seems that the cause of the explosion was due to a crack in the plate where the boiler was lap jointed. There appears to be quite a prevalent impression among engineers that fire shell boilers having fire tubes, can be used only for a short time at anything like the maximum pressure, and that a reduction in pressure is likely to be made on such boilers by the inspectors, within a few years after they are put in place.

Presumably the boiler explosion referred to will have the effect of cutting down the pressures on a good many boilers in the state of Massachusetts, when the boiler has been run for a certain time. It would not seem that the boiler which exploded could be considered an old boiler being in use less than 15 years, or that a pressure of 90 pounds was anything out of the ordinary. I have operated a good many boilers, but I did not consider one 15 years of age a candidate for reduction in pressure. I have seen boilers 25 years old carrying between 80 and 90 pounds and according to the inspector they were in as good condition as they were 15 years before, although I will admit that a boiler 25 years in service is old enough to begin to think of working at a little less pressure.

It appears to me that an intimate and correct knowledge of the true facts regarding the reduction of boiler pressure would show that the belief that it is always necessary to cut down the pressure, is without foundation. Engineers can rest assured that pressures are not reduced because a boiler happens to be five or six years old, but from the fact that boilers are often sold with an assurance to the buyer, that they are perfectly safe to operate at a pressure of 125 to 150 pounds, as the case may be. Not many of us would care to run a horizontal tubular boiler at much over 125 pounds, but when a manufacturer buys a boiler with this understanding, it is natural that he should feel that something was wrong when the inspector will not allow him to carry more than 100 pounds pressure. In such a case the inspector is not to blame, nor the company he represents, but it lies rather in the calculation on which the boiler maker's statement is based.

There are many boilers operating with a factor of safety of 3½ or even as low as 3, while every engineer knows that all boilers should have a factor of safety of not less than 5, except in certain cases where the material has received rigid inspection and tests and the construction has been carried out under the watchful eye of some one who understands such things and is not interested in how much money the boiler company makes out of it. In such cases a factor of 4 is sometimes allowed.

It is no uncommon thing for a manufacturer to put in a new steam plant, because he needs a boiler pressure of 125 pounds or more. The material in the boiler will doubtless be of good quality, but it may not be up to the proper thickness, the work may be all right and well done, but the design of the boiler may not be exactly as it should. Such conditions are by no means uncommon and might justify the inspector in allowing the boiler to operate for a few years with a factor of safety as low as 4, but when this is done the boiler should be under constant observation for any signs of distress or weakness. At the end of a few years the inspector decides that it is time for the boiler to operate under a factor of safety of 5, and when this is done the pressure must of course be reduced.

Now we can see that this reduction of pressure was not brought about because of any defect in the material or workmanship in the boiler shell, but from the fact that it was not properly designed in the first place to enable it to run at the pressure desired.

I am firmly of the opinion that the tendency of boiler makers is to rate their boilers too high. We know that a small cylinder boiler can safely carry 60 or 70 pounds, which a few years ago seemed to be the average pressure, and a boiler 60 inches in diameter with this pressure would have as a general thing a factor of 5. We find today, however, that the pressure of boilers has increased and the conditions are changed and the average pressure is more like 100 pounds per square inch than that carried a few years ago.

When higher pressures and greater diameters came into use, a corresponding change in boiler construction was also called for, in order that new conditions or practices might be properly met and provided for. The improvement in boiler making with the increase of the steam pressure has not been by any means universal and many builders continue to use, on boilers designed to carry 100 pounds, or more, practically the same design, method of construction and material that they have always been in the habit of using for boilers which they designed to carry 75 and 80 pounds pressure.

Boilers of this kind when put in service at pressures at which they are rated by the makers are often cut down, when examined by the inspector, to operate under a pressure which will be practically safe.

We are told in the article referred to that the pressure of the exploded boiler had been reduced, but from what cause no mention was made. It is quite likely that it was because the inspectors found the boiler was not designed and constructed for carrying a high steam pressure.

One of the most important things about a good boiler is good material, but even with the best of material, it is quite possible to produce an inferior boiler, as the experience of many engineers will corroborate, and the commonest source of weakness is without a doubt, the use of poorly designed rivited joints.

The fallacy of allowing 56 or 70 per cent respectively for single and double riveted joints without regard to the actual proportions of the joint has been proven in many instances, and has shown that there is danger in applying the blind rule of 56 and 70 per cent in all cases, without regard to the actual facts.

I have in mind a boiler which the builders rated at 70 per cent of the solid plate at the joint, and it was sold with the statement that a factor of 4 was allowed. This meant that with the boiler working at a pressure of 110 pounds, a safety factor of 4 would still exist When the real efficiency of the joint was looked into it was found that it was only 48 per cent instead of 70. This would bring the bursting pressure down about 300 pounds and in order to run at 110 pounds pressure the factor of safety would have been about 2.75, which every engineer knows is altogether too low. The boiler was insured by a boiler insurance company and in examination they would not allow a safety factor of less than 5, which brought the working pressure down to less than 50 pounds, a trifle less than half of what the owner required. He undoubtedly has his opinion as to boiler inspectors in general.

The boiler had been misrepresented to him in the first place, and was also badly constructed, let alone being operated at a point very near the danger line from the time it was first put in use. If a boiler is correctly designed and constructed so as to have a factor of safety of 5, it is no more liable to a reduction of pressure than any other pipe or boiler. To my mind the butt joint type of boiler is preferable to the lapped joint, for the reason that the boiler shell is always in a true circle and the effects of the contortions of the plate due to the change in pressure when the lapped joint is employed, are done away with.

A. M. Hamilton.

First Class Plants.

Editor of the Engineers' Review:

From some of the letters which appear in the Review, one would suppose that there was not much difference between a first class plant and others of lesser importance. Every one will concede that a first class plant should have a first class engineer to operate it, but there seems to be a difference in opinion as to what constitutes a first class plant. The majority of engineers will doubtless say it should be large and contain the best and latest improved machines and boilers that can be had. There must of course, be sufficient firemen and oilers as well as assistant engineers, and in fact every thing up to the highest mark. The above is the ideal plant of the average engineer.

My ideas of a first class plant are as follows: The boiler should be well made and large enough to do the work, without laboring or being forced; the engine of sufficient size to allow the cutoff to occur at about ¼ stroke when pulling its ordinary load; the engine to balance the boiler and the boiler balance the engine, and sufficient auxiliaries to make the plant convenient to handle and economical in operation. A first class plant does not mean that it must be large and developing thousands of horsepower.

A first class plant may be operated by one man who both fires and acts as the engineer. It is not so much the size, as it is the manner in which the plant is kept up. There are many large plants which are of the first class, but as a general thing the man who has charge of them does not know his men as he should, and, therefore, does not get to know all about the different details of the plant as will the engineer in a smaller plant. The only way to know one's help is to mingle with them, and find out personally how and what they are doing. If the information comes from one of the assistants, no dependence can be placed on what he says, because if a man is mean enough to inform upon his fellow workmen he will also add a few lies to brighten the story up a little.

The first class engineer is not always the man operating the large plant, but is, in the opinion of many, the man who can make his plant do its work as economically as it is posible. He is the man who can give an opinion about things without having to wait until others have expressed an opinion and then gracefully chime in and agree to all that has been said.

If he does not know his business it will take a good deal of bluffing in order to make an impression with those under him and then it will be a failure, as "bluffs" will not answer from a chief engineer. The first class plant contains not only smooth running machinery, but smooth working men who are capable of doing their work, and know how to work together without friction. Herman Palmer.

A Safety Valve Puzzle.

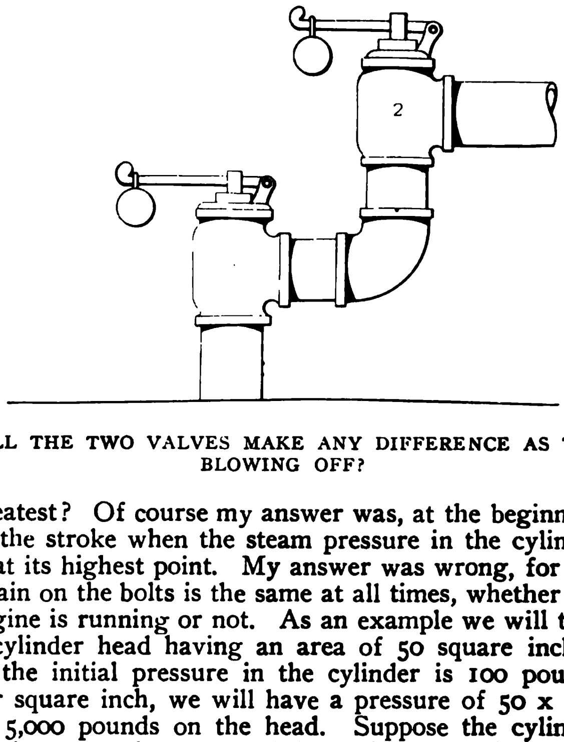
Editor of the Engineers' Review:

I have a little safety valve problem I would like some help on from the readers of the Engineers' Review, as I have had all my calculations knocked in the head by an answer given in an engineering paper. The question is: A safety valve on a boiler is set so as to blow off at 100 pounds gage pressure. It another safety valve is connected to the outlet of No. 1, as shown in the illustration, what will be the pressure in the boiler when safety valve No. 2 is beginning to blowoff?

The answer given in the engineering journal was that the safety valves would blowoff anywhere between 100 and 200 pounds gage pressure. They had a lot of figuring to substantiate their theory, but nevertheless I was not able to understand it at all. I do not see how valve No. 1 can operate under a pressure less than 200 pounds, for this reason. As soon as the steam pressure reaches 100 pounds, safety valve No. 1 will commence to blowoff, but will close as soon as the pressure in the waste pipe begins to raise. As soon as the boiler pressure reaches a higher point the valve will open again, only to close as soon as the back pressure on top of the valve plus the pressure due to the spring is greater than the boiler pressure. This action will be repeated until the pressure in the boiler reaches 200 pounds.

As the pressure necessary to raise safety valve No. 2 is 100 pounds there will be a back pressure on valve No. 1 of 100 pounds plus the pressure due to the spring. Then it must surely take 200 pounds pressure to raise valve No. 1, as the back pressure would act the same as a weight on top of the valve. Of course it would take a little more than 200 pounds pressure, but I am just estimating it approximately. I would be glad if some of the boys could show me in what respect my calculations are wrong.

Another question that I had in an examination was: At what time is the tensile strain on cylinder bolts the greatest? Of course my answer was, at the beginning of the stroke when the steam pressure in the cylinder is at its highest point. My answer was wrong, for the strain on the bolts is the same at all times, whether the engine is running or not. As an example we will take a cylinder head having an area of 50 square inches. If the initial pressure in the cylinder is 100 pounds per square inch, we will have a pressure of 50 x 100 or 5,000 pounds on the head. Suppose the cylinder head nuts are just screwed down tight enough to keep it from leading, then there is a tensile stress on the bolts of 5,000 pounds. Suppose then the nuts are tightened until there is a tensile strain on the bolts of 10,000 pounds, then the strain will remain the same until the pressure on the head exceeds 10,000 pounds.



WILL THE TWO VALVES MAKE ANY DIFFERENCE AS TO BLOWING OFF?

This may look unreasonable at first, but a little study will soon make it clear. It is the same way with a spring safety valve, for the spring exerts the same pressure on the valve when the steam is 50 pounds or 5 pounds and continues to do so until the pressure on the valve overcomes the pressure due to the compression of the spring. I hope this point is made clear, for it puzzled me until I had an explanation of it.

Guy B. Cooley.

Scale as a Cause of Boiler Explosion.

Editor of the Engineers' Review:

The writer was particularly interested in the letter from L. S. in the July issue, in which he talks of scale accumulation as a cause of boiler explosion. The writer was about to address you on almost the identical subject, when the letter of L. S. appeared.

Of course there is no positive proof that scale acumulation has caused, or will cause, boiler explosion, but many defects due to this cause have been discovered in time to prevent an explosion, and it is reasonable to assume that many defects caused by scale passing unnoticed, even to inspectors, have caused explosions.

Mechanical cleaning of boiler tubes has in many instances revealed tubes which are absolutely burnt off at the ends and were held in place by the ring of scale which had accumulated. Now is it not fair to assume that if under pressure, this shell of scale should become dislodged and the whole force of the pressure, of the boiler turned against this one weak spot, that an explosion would result?

As one looks more and more into the evil caused by scale on the physical structure of a boiler tube and sees the condition of many tubes which have been removed from boilers, pitted many times from end to end and burnt out at the header, in the language of L. S., "we wonder how they ever held together to be removed by human agencies."

Ordinary methods of inspecting boilers fail to disclose weaknesses of this sort, for it is impossible for any inspector to see the interior, or to examine every inch of a boiler tube, and it is only when a nasty leak developes, that anyone gives thought to the possibility of a bad tube and the necessity of replacing it.

The writer is a strong advocate of mechanical cleaners, hammer cleaners, for they tell the true condition of each and every tube, and if the tube is pitted or burnt out, the defect is shown when water is turned on.

I know of quite a number of instances where hammer cleaners have been condemned simply because they have disclosed leaky tubes, the claim being made that the cleaner made the tube leak, when it was only the removal of the scale by the cleaner which caused the leak and showed the actual condition of the tube.

It seems to me that these self same individuals who condemn hammer cleaners should thank fortune that they have been invented, for instead of damaging any tube, they forewarn the engineer of serious defect, which he may remedy before disaster occurs.

Again too, these hammer cleaners will disclose little weaknesses, such as a leaky tube around the header, which may be remedied by expanding at a slight cost, when first made known, while if such conditions were not made known, the tube later would have to be removed and a new one welded in.

While perhaps it is advocating a pretty strong measure, it seems to me that if boiler inspectors would make their examinations of the tubes with these same hammer cleaners, they would then know the exact condition of every tube, and the number of explosions which have occurred "A few days after an inspector's visit" would be reduced. B. L. D.

Report Sheets.

Editor of the Engineers' Review:

In reading a recent number of the Engineers' Review I noticed an article entitled "Value of Report Sheet" by M. J. Lessick, which I think was very good. A report sheet should be used by all engineers. The above shows one which will fill the requirements in many plants. Sheets have to be made of course according to the needs of one's plant, but I think every engineer should have some kind of a system about his work and all that belongs to his department. One way of maintaining a system is to keep a truthful record of all connected with the department and the cost of every little thing. The record should show in fact every item that enters into the cost of running the plant.

Engineer's Report.

Week Ending June 30, 1905.

Day of Week		Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	av. for week
Boilers	Number 1								
	" 2								
	" 3								
	" 4								
Draft in inch-water									
Temperature of feed F.									
Average steam pressure									
Coal	Lbs. used								
	" per H. P.								
	" per lbs w'r								
Water	Lbs. used								
	" per H. P.								
	" per lb coal								
ENGINES	Number 1								
	Number 2								
Vac. Number 1									
Vac. Number 2									
Supplies	Rod Packing								
	Gasket, Rubber								
	Candle Wick'g								
	Cyl. oil, pts.								
	Eng. oil, pts								
	Grease, lbs.								
	White waste lbs								
	Col'd Waste lbs								
	Wanted								

Remarks:

Most any firm will furnish their engineer with some kind of a record sheet, but if not the engineer can get a book and rule it to suit himself and his plant, and if he keeps a truthful record it may help him out of some future trouble.

The repair items come in very handy as they show whether good results are being obtained from his packing, etc., and if a change would cut down his packing bills.

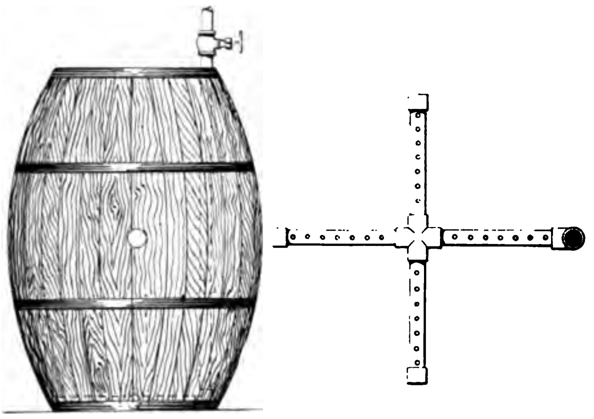


FIG. 1. BARREL FOR WASHING WASTE.

The engine room should be kept clean and the use of any more oil than is necessary, avoided. Waste is cheap, but after it is used, put it in a can and when you have enough get an old barrel and fit it up as shown in Fig. 1 with a heating coil which is shown at the right of the barrel. Then fill the barrel about half full of water, using soap or sal-soda and boil till the waste is clean. After it is dry it can be used over again. This helps to cut expenses.

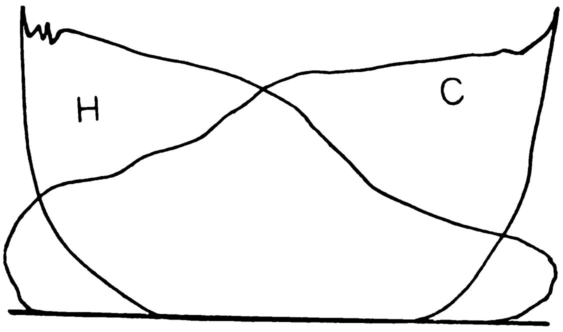


FIG. 2. CARD TAKEN WITH CONSTANT LOAD.

Now I would like to ask the readers of the Review to give their opinion of the two indicator diagrams, Figs. 2 and 3. The diagram Fig. 2 was taken from a 14¼x16-inch Buckeye engine. Boiler pressure 75 pounds, running 270 revolutions a minute, scale of spring, 50. This engine has a constant load as it runs an electric light machine. Could this diagram be improved any by changing the valves?

The diagram Fig. 3 was taken from a Buckeye engine 8¾x12 inches, boiler pressure 80 pounds, running 320 revolutions a minute; scale of spring, 50. This engine has a constant load as it is used to run a blower.

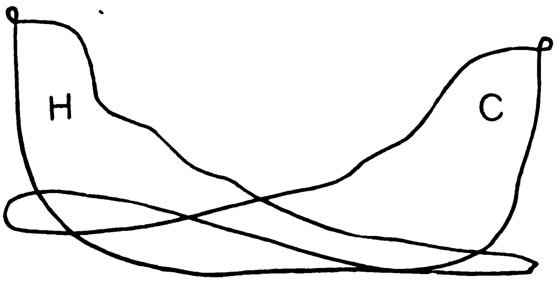


FIG. 3. WHAT CAUSES THE LOOPS?

What causes the loop on the crank end on the counter pressure line, also loops at both ends on compression line? Lincoln A. Cole.

The Tramp Engineer.

Editor of the Engineers' Review:

I notice that Bill B. Banger has taken a crack at the tramp engineer and while Bill usually hits the nail on the head and probably does this time as far as his experience with them goes, still it is possible that others have had experiences which have been somewhat different, and not at all to their detriment. I think that he draws the line a little too marked when he pictures the tramp engineer as he does. I don't think I have ever met the kind of tramp engineer Bill describes, although I have met several who might be called a typical tramp engineer and those who approach nearest to my idea of him are pretty smart capable fellows. The only trouble with them is that they won't work in a place long enough to get married to the job. They like new scenes and experiences and won't take back talk from anybody.

To my mind there are several reasons why a man of a roving disposition who has followed the engineering business for several years will be able to give pointers to a man who has huddled down in one plant for the same length of time. Certainly one gets a more varied experience than the other, at least, because he has the opportunity, and as no two plants are equipped the same, or would operate the same if they were, it is evident he has a greater opportunity for observing the peculiarities and working of each, and of getting information about engines and plant equipment, than he would were he to content himself to settle down in one plant day after day.

One will find that there are many engineers prone to give advice who are not tramps. I have never had to wait for him to come around in order to get advice, as there were always plenty willing to do this, in the same ratio as a crowd of men give advice to the driver of a balky horse when it refuses to move.

I envy the man who goes about and sees things, and he has a better knowledge as to the general run of plants than the "stay at home" class. As I have been through the mill during my earlier experiences as an engineer, I do not hesitate to say that a man can gain experience in no better way than by moving from one plant to another, if he has no tie to prevent him from doing so. The greater the variety of plants an engineer operates the more experience he certainly will get.

If this is the case, why is it not reasonable to suppose that if he has ordinary intelligence, he will be able to give pointers to the man who has only operated one or two plants during his career? I feel satisfied that he can, and while I would not encourage engineers to adopt the policy of remaining in one plant for only a short period, I do believe that it is a good thing to make occasional changes. If a man stays in a plant too long, he soon gets to feel that he owns the concern and when that happens, something is liable to drop. I have little use, however, for an engineer of the type depicted by our friend, Bill.

I. C. Lloyd.

Homemade Condenser.

Editor of the Engineers' Review:

The controversy among different readers, started some time ago by Mr. Governor in "Engine Room Chats" and which has been kept hot by various correspondents since, has been rather interesting, although not much headway has been made as far as an agreement of ideas go. I presume every engineer has his own ideas regarding the efficiency of the different types of pumps. I don't know as my opinion will amount to much over that of others, but as I have operated duplex, simplex and power pumps. I feel that I am in a position to, at least, have ideas on the subject.

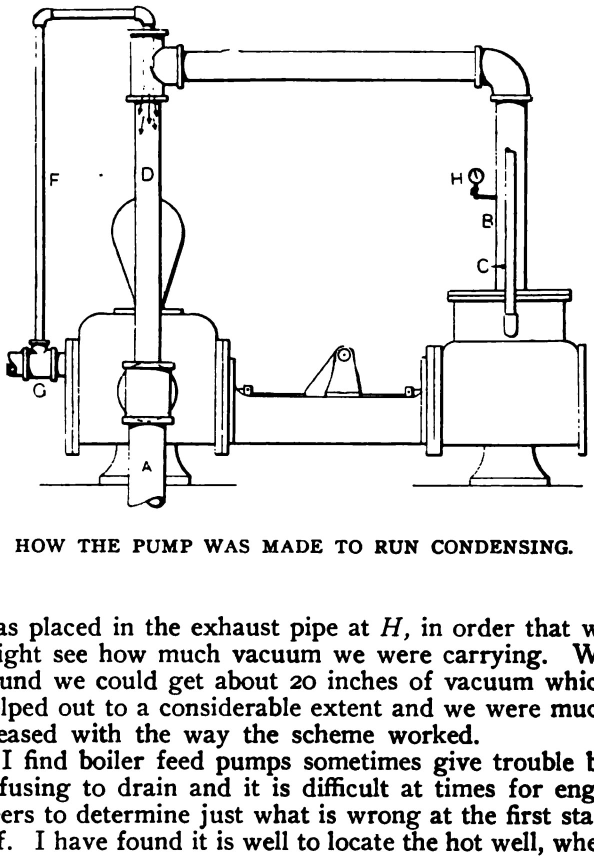
I have read the letters which have not spoken very highly of the simplex pump, the main objection to the pump being, that it will stop if the steam supply is cut off, or the boiler pressure drops to any great degree. This is true in some instances, but I believe the trouble is because the pump is too large for the work it is supposed to do. If the pump is larger than there is any need of, it must, of course, be run at a speed considerable slower than it would if the water supply it was supposed to pump, was very near its full capacity. When the pump is large it either has to be run slow all the time or allowed to run at a normal rate of speed, then be stopped for a time until the water level in the boiler drops. If the pump were of a smaller capacity there would be no need of running it so slow, and therefore a variation in steam pressure would not affect it enough to cause it to stop.

The duplex pump never gave me any trouble, that I can recollect, except that when the water plungers required packing, I found two instead of one. I do think they use more steam and are more expensive to operate than the simplex, but they are reliable, and can be depended upon when once started, at least that has been my experience.

When it comes to a power pump, however, I will take off my hat to it, because I have found that for all around satisfaction, the power pump will give it, when conditions are such that it can be used. I cannot understand why more of them are not used, as the only real objections I have ever heard advanced in opposition to their use, is that they cannot be used after the engine is stopped and that the belt is liable to break; both of which are true. To the first, however, I will say it is very seldom a pump is wanted after the power is stopped because, if an engineer uses judgment his boilers will be full enough to leave when he shuts down.

An injector should be had regardless of the type of pump as it can be used when the power is shut off. I have found that with a power pump of suitable size, a most satisfactory feed is produced, and by having a bypass from the discharge pipe and suction it is no trouble whatever to regulate the feed to suit the load on the boiler.

A scheme that has been worked in our plant with considerable success is shown in the illustration which explains itself. We got the idea that our pump would give better satisfaction if it could be run condensing, and as we had no condenser we piped up the exhaust to the suction pipe as shown. It will be seen that *A*, is a suction pipe to the pump, *B* is the exhaust pipe from the pump, *C* the steam pipe supplying the pump with steam, and *D* the exhaust pipe connecting with the suction pipe. In order to get the condenser effect we inserted a tee and bushed the upper end, which had a ¾-inch pipe *F*, connected to the discharge pipe at *G*. In the pipe *F* a valve was placed in order to regulate the supply of condensing water, while a vacuum gage was placed in the exhaust pipe at *H*, in order that we might see how much vacuum we were carrying. We found we could get about 20 inches of vacuum which helped out to a considerable extent and we were much pleased with the way the scheme worked.



HOW THE PUMP WAS MADE TO RUN CONDENSING.

I find boiler feed pumps sometimes give trouble by refusing to drain and it is difficult at times for engineers to determine just what is wrong at the first start off. I have found it is well to locate the hot well, when possible, above the pump, and place a stop cock in the suction pipe as near the hot well as possible, to regulate the flow of water and then make the pump work continuously. This is one of my hobbies and I firmly believe that continuous feeding into a boiler is better for the boiler and is a help in its steaming qualities.

I have had pumps refuse to work because the suction pipe had a leak in one of its joints and the trouble was made worse because the hot well was below instead of over the pump. I find a good way for testing leaks is to lock the cock between the boiler and check-valve and then remove the check valve disk as well as the suction and the deliverv valves of the pump. After replacing the valve and pump cap, open the valve between the boiler and check valve. Then the pressure of the steam in the boiler will drive the water before it and force it through any leaky joint that may exist. James Walker.

Governor Pounds.

Editor of the Engineers' Review:

In the June issue of the Review I noticed a letter by M. A. Stedman headed "His Governor Pounds." I am very much in sympathy with him, having had an experience of the same kind during the past year, with a 125-horsepower automatic engine. At times it would run like a sewing machine, but about the time the manager or some visiting engineer stepped in, it would start a tune that would break any man's heart.

After much adjusting of the governor and a great deal of experimenting, I came to the conclusion that the trouble was in the lubrication of the valve. I sent for a can of graphite and fed in a little with my cylinder oil, and as if by magic, the trouble disappeared. Always since then, when I hear the governor start that ominous click, a little graphite is the remedy.

I cannot explain the reason for improper lubrication except in this way. Our boilers were a trifle too small, and when the engine was pulling hard, it drew over wet steam. I advise Stedman to try graphite with his cylinder oil. Robt. L. Weber.

Pounding Governors.

Editor of the Engineers' Review:

I have taken note in the June issue of the Review, what Mr. Stedman says in regard to his governor pounding. It has been my misfortune to have control of engines with automatic governors for the past eight years. I have handled several types of shaft governors, and my experience with them has been that the majority of them pound at intervals, especially the more complicated types, having several bearings. It takes but a very small amount of lost motion to make a governor pound when it is running light, or at the extreme end of its travel. On the other hand, an extremely heavy load thrown on suddenly, will cause the arms to drop back with a pound.

I am running at present two high speed engines, one running at 280 revolutions per minute, and the other 350. By keeping them tight they run very satisfactory, but if allowed to become the least bit loose, they pound at intervals. I consider the Rite's governor to be the most satisfactory running, owing to its having only one bearing, and that with adjustable bushing.

A. H. Lane.

Governor Speeds.

Editor of the Engineers Review:

I have here-to-fore held my peace and read the columns of the Review for the benefit I received, but can I receive any benefit from F. G. Van Orman's letter in the April issue, page 33, on Governor Speed? The Speed of my governor does not change; should I change the pulley on the governor shaft? A larger pulley on the governor shaft will require the engine to run faster in order to bring the governor up to speed. Thus with a governor shaft pulley 5 inches in diameter and speed of the governor 330 revolutions, we have 5 × 330 = 1,650. This divided by the size of the engine shaft pulley, which is 11 inches, equals 1, ÷ 11 = 150 revolutions of the engine, which is corr When he changes the governor pulley to 6-inch he have 6 × 330 = 1,980. Dividing this by 11 inches, size of the engine shaft pulley, he will have 1,980 ÷ = 180 revolutions or in other words his engine have to run 180 revolutions per minute to bring governor up to where it will regulate the engine.

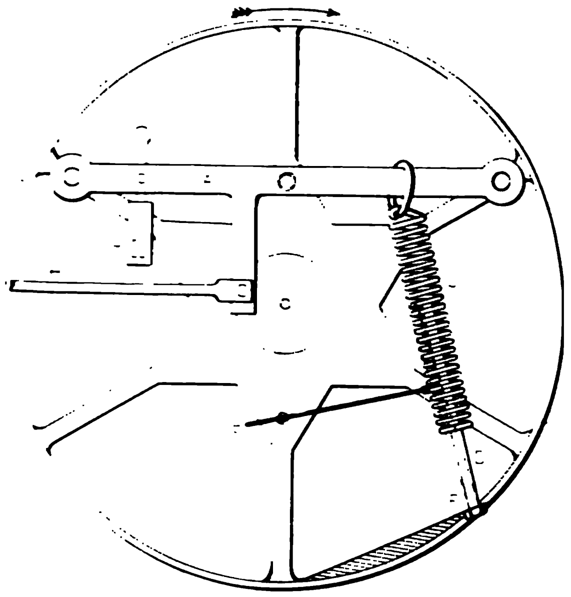
There are some good running engineers who a mislead in this one particular. E. H. Reiter.

Governor Troubles.

Editor of the Engineers' Review:

I will give the readers of the Review the bene of a little experience I once had with an automatic go ernor.

It was a McEwen engine equipped with a Begin governor, the parts of which are understood by refe



THE DOTTED LINES SHOW THE BENT SCREW BOLT.

ring to the illustration. *A* is the inertia bar pivoted suspended near the center as shown. *H* is the val rod which is connected to the arm cast on the inei bar, and giving motion to the valve through a roc shaft, not shown. *C* is a tension spring which enga one end of the inertia bar, and *D* is the tension scr for holding the tension on the spring and also making small variations in speed. *B* is a sort of s rod for the purpose of keeping the tension spr from being thrown out of line with the screw by action of centrifugal force. *T* is a dashpot for p venting too sudden fluctuations of the governor.

When I first took charge of the plant the man wh I relieved informed me that this engine had a habit racing badly at times. It was very noticeable on fi starting up and with no load except the station ligl It was quite puzzling for several days, the more on account of the extreme simplicity of the govern

Having an idle half day I decided to locate trouble and on starting to take out the tension screw I noticed it was crooked, having a short kink at point *F*, just inside the rim of the wheel. After taking the screw clear out I found it worn off wedge shaped, and almost to a point on the thread end. This explained the whole trouble. The end of the screw had been catching on the inside of the coils of the spring, and thus interfering with the working of the governor.

I figured that it had happened in this way: The stay rod *B*, or its coupling at the spring had been broken at some time and the spring being thrown out of line with the screw had bent it as shown at *F*. A new tension screw made it all O. K. and we were troubled no more with engine racing. A. Beginner.

Reply to Mr. Stedman.

Editor of the Engineers' Review:

I would like to give Mr. Stedman my experience with pounding in automatic governors. I took an iron bar and after I had raised the counter weights carefully, I could feel a slight catch. I took out two of the main studs, and found them worn a little flat on one side. The holes were rebored, new studs were put in, and the governor has run with scarcely a sound for nearly a year. An automatic governor is very liable to wear as it is hard to keep properly lubricated.

I would say to Saw Mill that graphite and oil are all I ever used on the studs of handhole plates of boilers, and I never had one burn out with me.

I don't think I would like to work for Mr. Philip Dase. He evidently doesn't know a good thing when he sees it. I am very much interested in the Review's letters and while I don't agree with all the boys in their ideas, I don't expect them all to agree with me.

L. F.

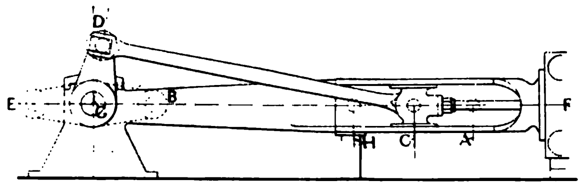
Irregular Travel of Crosshead.

Editor of the Engineers' Review:

I have been somewhat interested in the discussion which has been carried on by A. L. J. and Motor relative to the crosshead travel in connection with the movement of the crank, the contention being that the crosshead travel is less for the same movement of the crank on the outer portion of a stroke, than it is on the inner portion.

That there is a long and short quarter in the travel of the crank on a steam engine is quite evident. This is because the crosshead and crankpin cannot both be regular, and the irregularity of motion will naturally be assigned to the crosshead. That there is a difference in the travel of the crosshead during one quarter over that of the other, is evident when we refer to the illustration. Supposing the engine is on the head end dead center, the center line of the crosshead will stand at *A*, and the crank will be at *B*. If the stroke of the engine is 36 inches, the center of the crosshead will be at *C*, when it has traveled 18 inches, or ½ its stroke, and the crank will be in the position shown at *D*.

It will be seen by this, that the crank has not made ¼ of a revolution, although the crosshead has traveled ½ of its stroke, as would be proven if the connecting-rod were disconnected and allowed to drop until it was perfectly horizontal with the line *E F*, in which case it will be found that the center of the brasses came exactly even with the center of the engine shaft. If the connecting-rod is raised, however, from a horizontal position, the center of the brasses gradually draws away from the center line of the shaft, as shown by the line *D G*. It will be seen that when the crosshead has reached the point *H*, that the crank will be upon the crank end dead center, or at *E*, and that the arc of the circle described by the crank in making a revolution is greater from *D* to *E*, than it is from *B* to *D*. It will therefore be seen that the angularity of the connecting-rod causes the crosshead to travel an unequal distance in ratio to the distance traveled by the crank, during the first and second quarter of a revolution.



SHOWING THE RELATIVE DIFFERENCE IN TRAVEL BETWEEN THE CROSSHEAD AND CRANK.

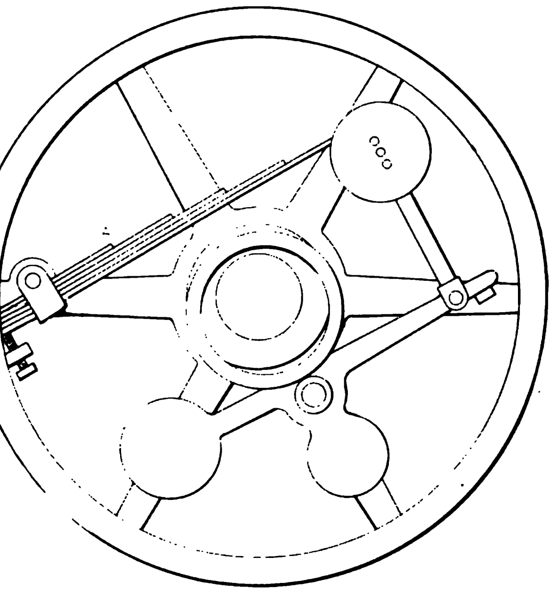
It is quite evident that Motor is correct when he says that this difference is caused by the angularity of the connecting-rod. There is no doubt but that the crank is traveling in a circle away from the crosshead for ¼ of its stroke and toward it on the next quarter, but this to my mind does not prove that the difference in motion is not due to the angularity of the connecting-rod.

F. Otis.

Engine Racing.

Editor of the Engineers' Review:

The question of engine racing has been discussed by several, but there are a few points relating to this matter which have not been touched upon, especially in the case of high speed engines.



GOVERNOR SPRING AND WEIGHTS.

I recall an instance of an engineer who had charge of a medium speed engine, running at about 180 revolutions per minute. Owing to changes of shafting in the shop, it was found upon starting up, that this was too fast for the machinery and rather than change pulleys, it was decided to change the speed of the engine, reducing it about 15 revolutions per minute. In order to do this the engineer loosened up on the tension of the spring, but made no other alterations, and when the engine was started up he found that the speed was very irregular, and the governor had a bad pound at intervals. This was something that had not been looked for, and he could not understand what was the trouble or what to do to remedy it, for some time.

After considerable tinkering around he came to the conclusion that if he increased the tension on the spring *A*, until the speed was brought up to the regular speed again and then added weights against which the spring could operate, it would reduce the speed the 15 revolutions as required. When this was done he found that his engine ran as steady as it formerly had before the change was made. Perhaps the trouble with Mr. Stedman is that he has been doing something along this line. If so the above will point out his remedy.

Visitor.

Firing.

Editor of the Engineers' Review:

The question of firing either by hand or stokers seems to be attracting much attention, there being advocates for both methods. In some plants the stoker is economical, while in others it is a question as to whether it is of any advantage or not.

It is the practice to install automatic stokers in most of the large electric stations, while in the lesser plants we find the two methods equally divided. There is an idea prevailing among engineers that where mechanical stokers are used, the fires receive no consideration whatever, as was brought out in a recent letter in the Review. This is a mistaken idea, although there is no doubt, but that in many plants using mechanical stokers, the fires receive less attention than is required for good work.

One of the causes of dissatisfaction with a stoker is due to the fact that the operation of the stoker is left too much to itself, and the advantages of the automatic apparatus for feeding, so far as bringing about an economy in fuel consumption, are not apparent. In fact if the neglect is sufficient the advantages of the stoker are defeated entirely. In the best practice the stokers and fires are watched just as closely as in the case of hand firing which means that the stokers must be assisted from time to time if the best results are to be obtained.

When boilers are fitted with plain grates the method of firing is frequently of uncertain character, and is often left to the care of an unintelligent fireman. With stationary grates it is often the practice to carry heavy fires and to throw on too much coal when the fires are renewed, both of which prevent perfect combustion of the gases and therefore lessen the economy.

The method of firing which is generally considered best both for economy and capacity is in carrying the fires at a thickness of 6 or 8 inches and applying the fresh fuel in small quantities at a time. It will be found by any one who is troubled with smoking chimneys, except in exceptional cases where coal will smoke despite all precautions that are used, that firing in this manner materially decreases the amount of smoke.

When boilers are overloaded and are forced, it is probable that more or less smoke will be made, but when they are not overloaded and the best of conditions regarding the quality of coal and firing prevail, the smoke would not be an objectionable feature. As far as I am able to judge both methods of firing have their objectionable and unobjectionable features.

Wm. Clifford.

Could Not Set the Eccentric.

Editor of the Engineers' Review:

Considerable has been said in the Review recently concerning engineers, good and bad. The disposition of some is to give the average stationary engineer a position of very little importance in the engineering field, while marine and locomotive engineers are so often commented on as heroes, who went down with the ship or died at the throttle. While I have no doubt that there are brave and efficient men in both the marine and locomotive service, I am sure that the stationary branch is not without its class of engineers who would sacrifice as much as their brethren in other callings.

One name for stationary engineers who have not gained positions of prominence which has been adopted is that of starters and stoppers. To show that there is as great a lack of general knowledge among locomotive engineers in one case at least, as among stationary men, I submit the following which was clipped from a paper published in a town through which the C. B. & Q. railroad passes. It reads as follows: "Engine No. 1216, pulling No. 9, broke down at this station today just as it was ready to pull out. The trouble was with the right back eccentric which slipped and practically disabled the engine. After about 15 minutes' delay spent in trying to remedy the difficulty by the trainmen, engine No. 1212 which was hauling a freight and standing on a side track was used to pull the train to the end of the division while the disabled engine was sent to the shops for repairs."

I will say that No. 9 was a west-bound passenger train and the engine crew supposedly one of the best on the road, but just the same they could not set the eccentric of their engine when it slipped. I can well imagine the story that would be floating around the town if such a thing happened to my engine and I was unable to set it.

E. C. Kennedy.

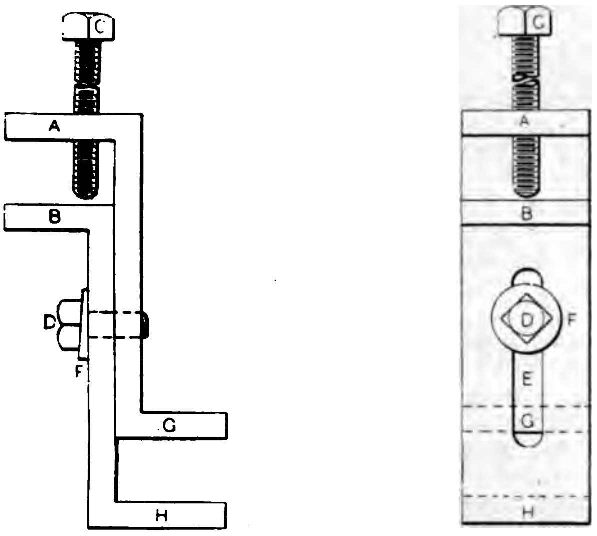
Device For Removing a Gland.

Editor of the Engineers' Review:

I wonder if any of the readers of the Review ever tried to pack the piston-rod on the low pressure side of a compound engine, and found the gland stuck so fast in the stuffingbox, that it was impossible to move it, even with a pinch bars.

That was the experience I met with a few months ago when I was repacking my cross-compound. As the packing had given no trouble for about a year, there was no need of changing it, until I commenced to notice that I had to run the condenser pump faster in order to hold a good vacuum, and if I tightened the gland nuts, the rod would heat up. When I tried to start the gland I could not.

Had it been the high pressure side, I might have blown it out by setting the engine on a dead centre and giving it steam on the crank end, but any man of experience knows that would not be a safe thing to do with a low pressure cylinder.



DEVICE FOR REMOVING STUFFINGBOX GLAND.

After trying every method I could think of, I could see but one way that would start it. If I could put something like a little jack, on two opposite sides of the piston-rod, and between the gland and the cylinder head, it certainly would have to start. I made two small jacks, as illustrated, out of 1¼ x ½-inch flat iron, and 6 inches long.

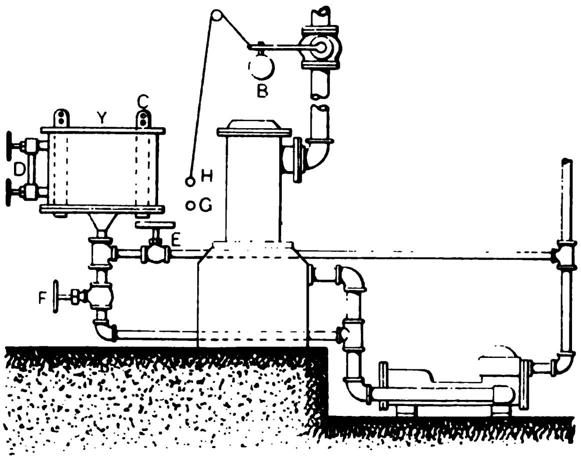
Referring to the sketch the slot *E*, is made for a ⅜-inch bolt, and is 2 inches long. The bolt *D*, is screwed into the under plate with a washer *F*, under the head. *C* is a ½-inch bolt 3½ inches long, tapped into the top of *A*, and bears against the top of *B*. By screwing down the bolt, it can be readily seen that the distance between *H* and *G* increases. After shutting down that night, I placed the jacks behind the gland, on opposite sides of the piston-rod, letting *H* bear against the cylinder head, and *G*, against the back of the gland. Then by screwing down on the bolts *C*, of each jack and following them both up evenly, so as not to cramp the gland, I was surprised to see how easily it started. Perhaps the idea may help some one out of a similar scrape. F. P. Kinder.

A Compound Tank With an Open Heater.

Editor of the Engineers' Review:

I have been using several different compounds and have had several different ways of putting them into the boilers, until a short time ago, when I concluded to have an analysis made of the water that is being used in the boilers, and soon received a specially prepared compound which had to be dissolved in hot water.

I procured a galvanized iron tank, 36 inches long, 30 inches high and 12 inches wide, and open at the top. As we have an open heater it was necessary to arrange some way of opening the back pressure valve, to allow the compound to flow from the tank to the pump. The cord in the accompanying sketch shows how the valve is opened, the ring in the cord at *H*, is passed over the bolt in the wall at *G*, thus holding the back-pressure valve open as long as is desired. The 1¼-inch valve at *E*, is on the pipe leading from the boiler-feed discharge line, thus affording hot water under pressure to the tank at any time. This line is often of great advantage to clean out the compound that might not be completely dissolved, and lodge in the pipe, anywhere between tank *Y*, and the pump water cylinder. The valve *F* is the feed valve, which, when opened allows the compound to flow by gravitation into the 3-inch suction pipe, then to the pump, and from there to the boiler. The straps at *C* have each two ¾-inch bolts 14 inches long, which extend through a 12-inch retaining wall. The water glass at *D* is very convenient to show how fast the compound is feeding. To operate it, first put the compound in the tank, then fill the tank with hot water through the valve *E*. When the tank is filled, pull down the rope, to open the back pressure valve and make the rope fast at *G*, then open the valve *F* and the compound will immediately begin to flow into the pump. "C. W. D."



COMPOUND TANK, HEATER AND PUMP.

Copper Wire Gaskets.

Editor of the Engineers' Review:

A practice that is followed by some engineers rather than using the soft packing as is most common for their steam chest is that of using copper wire gaskets. There are several ways in which such gaskets can be use. One is to plane shallow grooves in the chest, then form the gasket and braze the ends together, making a complete square or rectangular gasket without a joint.

Another method is that of grooving the steam chest to the size of the copper wire used, that is, if 3-16-inch wire is used, the grooves should be 3-16-inch wide and about 1-16-inch deep, making the grooves semicircular so that the wire when bedded shall touch thoroughly all the way around. When this is done the fitting of the gasket is easily and quickly done and when once done the gasket becomes a permanent part of the steam chest, and does not come off as in the case of the gasket which is brazed.

When using wire for gaskets, it should first be annealed and cut slightly longer than would be required when the gasket is in the groove. When annealing the wire it should be uniformly red hot by coiling and turning it. After the right temperature has been obtained, it should be dipped in cold water. This makes the copper very soft and easy to work. In forming the gasket, it should be put in a vise, several inches from the end, and bent at right angles by hammering it against the end of the vise jaws, striking the hammer upon a wooden block to prevent jamming the wire. The wire should be next laid on the steam chest and mark the place for the next bend and so on until the four corners have been made, after which, saw off the gasket at the proper length so that the wires will butt together about 1-16-inch longer than the groove, from corner to corner.

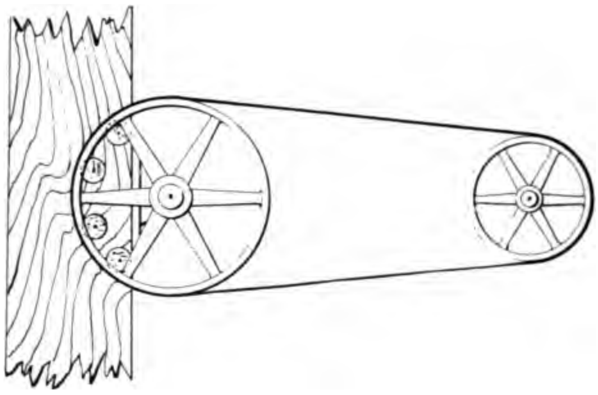
When the gasket is completed it should be driven into the groove in the steam chest using hard wood blocks to hammer on to prevent scarring the face of the gasket. When the gasket is in the groove, see that the corners are firmly in position, and then bend down the ends, hammering them into place, also the intervening sections between the ends and the corners. This will make a joint so close that leakage will not occur if the job has been done properly. If for any reason the joint is imperfect, a little calking, on the side will rectify the matter. This makes a gasket that can be relied upon and would be a favorite if it were used more.

A. C. Struckfus.

Substitute For a Loose Pulley.

Editor of the Engineers' Review:

I have in my plant an appliance which takes the place of a loose pulley, for a belt that is not much used. It does not wear by friction when the belt is standing as is the case with a loose pulley.



ROLLERS AS A SUBSTITUTE FOR A LOOSE PULLEY.

In the illustration are shown small rollers located near the flange of the driving pulley. The top roller is even with the face of the pulley or nearly so, the other three being a little nearer the shaft, the lower one being the nearest. I have no trouble in handling the belt by hand, although it is on a 36-inch wheel, running 315 revolutions a minute, but a stick is better for removing a large belt. The rollers on the device I am using are fastened to a 2 x 12-inch joist extending from the floor to the ceiling. The rollers turn on a lag or wood screws, screwed into the plank.

C. E. Bowe.

Bill B. Banger Has a New Experience.

Editor of the Engineers' Review:

Someone with a befuddled brain said some time or other, that if a man wants to improve his condition he should read and take notice of things. Well now this may all be true, but I have got a plugged three-cent piece that says it won't work every time.

I have been reading the Engineers' Review, as thorough as any one can, ever since Bill Jones began sending it over to me after he got through with it, in exchange for about eight hours work I did one night trying to set the slide valve on his engine.

The things that have struck me as near plump between the eyes as anything, are the letters that have been telling how an engineer should and shouldn't do work in his engine room. I read these letters, but I can't say that they profited me much, and I will tell you why.

In the town where I just moved to, you can't breathe if you don't belong to the union, and as I can't belong to them all my troubles seem to be rolling up higher and higher each day. Now some of the letters tell us that when an engineer ain't busy cussing the fireman, or squirting oil on to his engine, he ought to be busy about something else, in order to earn the pin money he gets on pay day. This was a kind of a knockout blow for me, as I have always been in the habit of kind of laying around and taking things easy after doing the things that were absolutely necessary, and so after reading these letters I thought I should save the firm about 17 cents by doing a little job of piping myself, and right here is where I struck a snag that pretty nigh swamped me.

When I do a job I always figure on doing it in a first-class way, and so, before I touched a tool, I sat down to make plans of the piping which was to run about 19 feet and 3 inches, and make a connection with another pipe. I had hardly got my pencil and paper ready before one of the draftsmen working for the firm came in and threatened to call a strike if I didn't put my drafting tools away. I tried to explain that I just wanted to draw a plan for personal use, but that didn't make a blame bit of difference. It was either have a draftsman do the job, have a strike, or do the work without plans, which I finally decided to do.

I didn't happen to have a pipe vise handy in the engine room, so I meandered into the machine shop, intending to clamp the pipe in the vise, and cut a thread on it there. I hadn't got the vise opened far enough to take the pipe, before a fellow wanted to know if I was an American citizen. I told him I was and then he wanted to see my card. I asked him what in tarnation a card had to do with it, and he said I couldn't use that vise unless I had one.

I told him I did belong to the union as I had been married for 17 years, but he said that wasn't the kind, so I had to get out, or else the machinists would have gone on a strike.

Well, I finally got my pipe cut off and threaded, and then I found that a hole had to be bored through a 12-inch wooden post, unless I made a bend out around it which is not good engineering practice. If that dinged draftsman had let me made my plans, I would have known the post was there, but as he didn't I didn't find it out until I come to run my pipe which, by the way, was only ¼-inch in diameter.

Well, I got the stepladder and had the hole bored

ıalf way through the post, when in came a
; delegate of the carpenters' union, and the
tore around there would have made one think
earning his salary, for once.

ık ahere," says he, "you'll have to stop that kind
do, or you will have a carpenter strike on your
n this shop."

at's the matter," says I, in a surprised tone of
ılthough I knew mighty well what was coming.
ıt's a carpenter's job," says he, "and we are all
together to give every man a square deal and
ɔrs."

hat so?" says I. "I suppose you figure it out
be a square deal and no favors to make me go
ase around and find a carpenter to bore a ½-
ıle, that will take about three minutes to do it,
ən soak the boss for an hour and a half time
ng the job?"

ɔ," says he, "and what's more, that's just what
got to do or there'll be trouble." He kindly
ered to find a carpenter, and while he was gone
ed boring the hole.

S A CARPENTER'S JOB," SAYS HE, "AND WE ARE ALL
'DED TOGETHER TO GIVE EVERY MAN A SQUARE
DEAL AND NO FAVORS."

ɜt got the pipe through the hole and was dosing
'eads with red lead and oil when a fellow came
. said: "Say, if you want to do any painting
l here you will have to get a regular painter
it." I just told him I wasn't painting, that I
ıing some pipe fitting, but he said it didn't make
fference. According to all rules and usages I
.inting, whether it was pipe fitting or something
nd if I didn't quit, things would come to a
ɜtill. While he was talking I just gave the pipe
le of twirls and gave the threads all the red lead
anted, and then told him that if that was the case,
.dn't cause any trouble to anybody. I just got
-inch pipe all connected up and taking things
vhen one of the pipe fitters came in and looked
ıf disappointed when he saw I wasn't doing
g.

ything doing, Bill," says he? "Not on your
ɜays I, looking as innocent as a four-weeks-old
"It don't pay to do anything more in this
than you have to" says I with a wink. He
. to that, and after shuffling around from one
ɔ the other for a minute, said, "I had an idea you might be doing something a little out of your line, and thought I would stop in and give you a gentle tip that every man is to have a square deal and no favors in this world." Right you are," says I, "and if that's what you are looking for, you come to the right place to get um."

That job of piping took about 30 minutes and didn't cost anything, but how long it would have taken and how much it would have cost no one, but the old Nick himself could have told if the walking delegate and square-deal-and-no-favor fellers had had their way.

If things keep on the way they have begun, I am figuring on moving back to Bangerville again.

Bill B. Banger.

Electric High and Low Water Alarms.

Editor of the Engineers' Review:

I notice on page 18 of the July issue that Scotty tells us how to equip our boilers with high and low alarms of the electrical type. I am in favor of high and low water alarms, but I would draw the line at his arrangement, although it may work satisfactorily in his case. The reason for so doing is that I do not believe it is reliable, and is therefore a source of danger. We all know that it is practically impossible to pack a stuffing-box so that it will be steam tight without more or less friction, and if the friction is so little as not to count the packing is pretty sure to leak. This is the last thing an engineer wishes to take place over a boiler, because a leak will cause corrosion of the plates. Providing that Scotty's alarm can be packed so that there is no friction, and at the same time no leaks, the battery is an objection to anything which is of such vital importance to the steam plant as the water column.

It is a common thing for dry batteries to give out, or become so weak that they are useless, while with batteries containing a solution of sal-ammoniac the wires connecting one to the other, are frequently eaten off and the circuit broken. Under such circumstances it is easy to see that the electric high and low water alarm would be useless. For my part, I prefer to depend upon either the old reliable water column, or one of the later types of safety water column, which are proving their usefulness every day.

It would appear from the letter by Mr. Houser on page 19 that the inspectors of our insurance companies are of considerable more importance than some engineers who have had but little experience with them are willing to give them credit for. After reading the report which he has given, I fail to see how any one can put up much of an argument to the contrary.

The boiler setting by G. M. B. on the same page has more the ear marks of an idiot than that of a mechanical man. Whoever designed the battery of boilers certainly had bright ideas. I don't see that it will take very much argument to convince any one that such a practice is altogether wrong and has not one single advantage to commend it.

F. B. Davis.

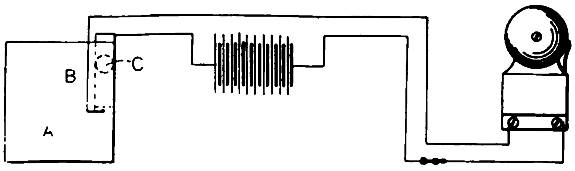
Another Tank Alarm.

Editor of the Engineers' Review:

To firemen or engineers who have trouble with their boiler feed tank running over, the following plan may be used to good advantage. Let *A* in the illustration represent a tank. I made a box *B* about 2½ feet long by 4 inches wide, to nail inside the tank at the top.

I then made a wooden float *C*, to fit loosely in the box *B*, and on top of this float I tacked a piece of copper to which was soldered a piece of wire long enough to allow the float to rise as the tank fills. I then stretched another wire across the top of the box *B*, and ran the two wires to a bell about 30 feet away. I used a common electric bell and three cells of dry batteries.

As will be seen, the water as it rises in the tank will push the float upward until it strikes the wire at the top of the box, thereby completing the circuit and ringing the bell. Of course a switch will have to be used to cut the circuit when the bell is ringing, until the water in the tank falls enough to disconnect the wires.



ALARM FOR FEEDWATER TANK

If the copper plate on the float is kept bright, as well as the wire across the top of the box, the bell is sure to ring and will be found very handy. Roger Rucker.

Theory and Practice.

Editor of the Engineers' Review:

Having read considerable in the Review concerning what helps to make a good engineer, and as there seems to be some who think that the technical man is of no use about a steam plant until he has had several years' experience, I enclose a clipping taken from the *Wisconsin Engineer* and written by C. H. Williams, which gives one instance where a college man made good and did not seem to have any trouble either in doing so. The article reads as follows:

"The local electric plant took on a recent graduate who had carried on considerable practical work along the line of analyzing flue gases which escape from the stacks of boilers.

"His first work with the company was along this line, with the hope that the operation of the station boilers would be improved and their efficiency increased. To best obtain these results, he made a study first of the men who were at that time handling the work. He became perfectly familiar with the methods of which they were making use, then brought them to a thorough understanding of what takes place within the furnaces when the fuel burns.

"After this had been accomplished (which took about three weeks), he introduced an Orsat apparatus, and after explaining its working to the men, he had them use it, and they analyzed the gas. The tests they made at first, of course, were crude, but they made them all themselves, and they saw the results improve. By this time the men were thoroughly alive to the interest of the matter, and instead of considering themselves simply tools to carry out the work of some one else, they were engineers doing scientific and practical engineering work themselves.

"A keen rivalry was established among the operators; they were working for results and obtained them, because they knew how to obtain them. The results were, that for the year following this work the fuel costs decreased 6.8 per cent on 7,500 tons of coal in a year, with coal at that time costing practically $4 per ton; this result to the employing company.

"The result to the man was that the company found that they needed just such another man for another place, and a better position elsewhere was found, and he was given it."

Some may say that the above is only one case, and that it is no proof that the same results will work out with others. I am of the opinion that a good man will never have to hunt for a position very long and that if he is up to date there will always be a place waiting for him. There is enough in the above to warrant a little thinking on the part of the engineers who read this communication. E. F. Wettstein.

Not All Glory.

Editor of the Engineers' Review:

Although belonging to the engineering walk in life, I cannot justly lay claim to the stationary department of the profession, being in the locomotive service. However, I receive and read the Review regularly. Some of the communications which are published suggest that stationary engineers feel their lot is cast in the hardest places that can be found, and the object of this letter is to give them a few ideas of what the locomotive engineer and fireman can expect or look forward to.

He must start as in every other walk of life at the lowest rung of the ladder, either in the position of a wiper, helper in the round house, or firing on a switch engine. Sometimes advancement is due to merit alone, but in most cases he awaits his turn for advancement. The fireman really has something to look forward to because he is desirous of becoming a running engineer. The engineer of course, looks forward to the time when he shall have a passenger run suited to his taste, but the steps from fireman to passenger engineer are many and rough.

When a wiper, or a helper gets promoted to the position of fireman, he usually finds himself booked in what is known as the extra list, where a life of uncertainty begins. He may come in from a run, snatch a few hours' sleep and be sent out again immediately. I have known of cases where a fireman would not be home more than one night out of seven. The stationary man thinks he is being imposed upon if he has to work two or three hours overtime in a month.

In four or five years, if fortune favors the fireman, he may get a regular run on a freight when his advancement will be slower than at the beginning. Provided he is fortunate enough to be appointed engineer, he finds that he must again descend and begin his climb upward which in time, if he manages to escape accidents, will land him on the right side of the cab on a passenger run.

There are more chances, however, that he will not reach this position than there are that he will, because the engineers who are pulling fast trains hold on to their positions, until they are too old to stand the strain, or die a natural death, get killed in an accident, or discharged because of some mishap. The latter probably is as frequent as any cause for an engineer losing his position. I know of engineers who have been running on freights for years who are living in the hope of getting a fast passenger run, but there is no more chance of their hope being realized than there is that I shall become the President of the United States.

Stationary engineers who read this will, I trust, be convinced that their occupation is not the most hopeless or disagreeable work, but that other branches of engineering have their drawbacks as well.

E. P. Conley.

Kinks and Comments.

Editor of the Engineers' Review:

On page 19 of the February issue, W. M. H. gives his way of fixing crankpin brasses which have become worn which is very good where one is so situated that he can have the brasses bored out to fit the pin after the metal has been poured.

I have been in places before now, where we were not so fortunate as to have a lathe, but the brasses had to be rebabbitted just the same. To accomplish this, we removed the brasses and took the old metal out of one side of the bearing and then connected up using wood liners of suitable thickness to hold the brasses far enough apart to get the proper amount of metal on that side. Having done this, with the pin resting upon the side from which the metal has not yet been removed, we filled around the edges with clay putty to prevent the hot metal from running out; it was then ready to be poured. The same process was then used for the other side.

The object in removing the old babbitt from only one side of the bearing at a time, is to preserve the alignment, as well as to keep the connecting-rod as nearly as possible the same length as formerly. If this is not done the box will invariably require boring out. All that is necessary after babbitting is to cut the oil grooves, smooth up slightly, connect up and all is ready to go ahead. I have seen this method used successfully on pins up to 6 inches in diameter.

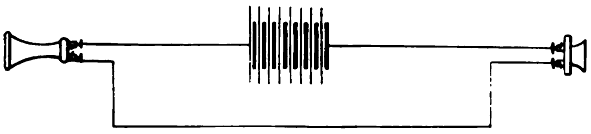
I am interested in the letters on the subjects of refrigeration and kindred industries and would like to read more of the experiences of others in this particular line of work.

O. Iler.

Pound Detector.

Editor of the Engineers' Review:

Sometimes it is very difficult to locate a knock in an engine and to overcome this difficulty I have used the following method:



TELEPHONE TRANSMITTER AND RECEIVER AS A POUND DETECTOR.

A telephone transmitter and receiver are connected to a dry battery as shown in the illustration.

When the receiver is placed to the ear and the transmitter against different parts of the engine the knock can be easily located. It is very interesting to listen to the noises in the cylinder.

W. M. G.

Tight Belts.

Editor of the Engineers' Review:

It would probably be a matter of considerable surprise to most engineers, if they were to make experiments relative to the effect tight belts have on the coal consumption of their plant. A noted feature of the average manufacturing plant is the unnecessary tension of belts which not only absorbs considerable power that should be utilized in doing useful work, but shortens the life of the belts as well, let alone the heating of journals and melting of the babbitt in them. Another bad feature of tight belts is that no shaft can remain long in line where the belts are run needlessly tight which results in extra coal burned, besides the excessive wear and tear on the plant.

If the tension of the belt were decreased and the diameter of the pulleys, or the width of the belt increased, it would be much more effectual and satisfactory than to run them too tight. In one plant where I am well acquainted, the friction and losses in the output amounts to 25 per cent, which is altogether too much.

A few simple rules, if adhered to, will alleviate this matter to a considerable extent. The driving pulley on line shafts should be placed as near the center of the work as possible, and whether it is convenient to locate the driving pulley at or near the center of the work or not, it is desirable in all cases to have a bearing on both sides of the pulley not over 4 feet apart, depending upon the size of the shaft to receive the pull of the belts.

The observing person will have noted that narrow belts are the ones usually run very tight, owing to the extra duty required of them in proportion to their strength.

No infallible rule can be given which will give the same result or efficiency in all cases regarding belts because there are so many circumstances and conditions which influence the driving power and the satisfactory working of the belts. To get the best results the ordinary individual must depend on common sense and the circumstances existing, in producing details and dimensions to meet his requirements.

Arthur E. Ludlow.

Soot as a Nonconductor.

Editor of the Engineers' Review:

The question of soot as a nonconductor of heat, which is being discussed by Motor and F. B. Douis, is not one on which very much data is available. Just how much heat is lost due to soot in the tubes, depends upon the thickness of the soot, and the number of the tubes. The information we have regarding this question is not reliable, and in fact, there never has been any experimenting to find the loss from soot that I am aware of. There will doubtless be a difference in losses from soot, from different kinds of fuel and different thicknesses.

We know however, that there must be a loss because soot is a good nonconductor of heat. This can be proven if one doubts, by placing the hand on the head of the boiler when it is covered with soot and again after cleaning the soot off. The difference will be so marked that there will not be any doubt in the mind of the skeptic after the trial.

Allowing soot to accumulate in the tubes of a boiler is the same as reducing the area of the tubes. Experiments along this line have proven that although the area of the tubes has been reduced, in some cases ¼, there was no noticeable difference in the weight of steam evaporated, but it is evident that the coal consumption would be increased and therefore the efficiency of the boiler would be decreased. If the fires are forced harder to obtain the necessary heat to evaporate a certain amount of water, it is evident that the flue gases are entering the stack at a higher temperature than they should. The temperature of flue gases should not be above 600 degrees and 500 is better. If a temperature above 600 is obtained, it is certain that there are heat units going up the stack which should be transformed into useful work.

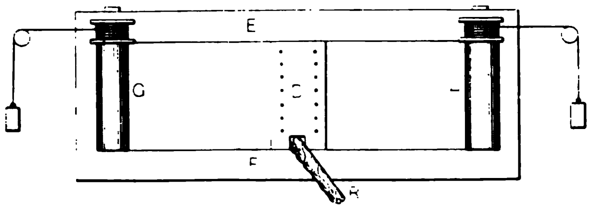
Whether the sides, top or bottom are the best parts of a tube to transmit heat to the water matters little. There is only one thing to do regarding the matter, and that is to keep the tubes clean, by cleaning them at least once a day, by whatever the method is used in the plant. If this is done there will be but little use in discussing the question as to how much of the tube surfaces are effectual.

W. Deming.

How the Hole Was Covered.

Editor of the Engineers' Review:

In the plant where I work we have three hoisting drums and as the rope is running in and out of the building all day and night, it makes it disagreeable for the engineer, when the weather is cold outside, as it is necessary to have an opening of at least 1 foot wide by 3 feet long. Sometimes when the weather was bad or blowing much snow, I would have a bag or burlap over the hole, but this would very soon wear out. So I finally hit on the following scheme: I took a piece of board about 12 inches long and 8 inches wide. In this I cut a hole just large enough for an 1½ inch rope. Then I made a slide *E* and *F*, for this board to slide in. On each end of the slide I had two rollers *G* and *H*, hung on brackets and fast to the top of the rollers were spools to wind the cord as shown. Then I got a piece of duck canvas which I wound around the rollers five or six times and tacked it to the slide board *D*, so that when the drum began to hoist, the slide board would give motion to the canvas and the weights attached to the rollers would either go up or down and wind or unwind the canvas as desired. *R* is the rope going from hoist drum out doors.



SLIDING BOARD OVER THE HOLE.

W. E. S.

Steam Plant Data.

Editor of the Engineers' Review:

I have seen several records of late applying to the engine and fireroom which are all right and serve their purpose as was intended. I have not, however, seen anything along the nature of the one I have hung up in my engine room which is not exactly a record, but it is more in the nature of a table of information regarding the various apparatus in the plant.

It is sometimes embarrassing to have someone step in and ask the dimension of some particular thing and not be able to give the desired information. If a record is made as shown, an engineer will be able to give all the information regarding details of his plant that he will likely be asked. For instance in the record it will be seen that there are two boilers and at a glance it shows the diameter, length of shell of the boilers, diameter and length of the tubes, also the number, rows of rivets, kind of joint, percentage of strength, safe working pressure figured with a safety factor of 5, kind of metal the boiler is made of, grate surface, heating surface, kind of safety valve and its dimensions, etc. Data regarding the engine is also given. Pump data and other information that would be of interest to have is not included in this record.

Boilers.	No. 1.	No. 2.
Diameter of boilers	60 inches	72 inches.
Length of shell	16 feet	16 feet.
Diameter of tubes	3 inches	3 inches.
Length of tubes	15 feet	15 feet.
Number of tubes	67	102.
Rows of rivets	Double riveted.	Double riveted.
Horizontal seams		Double straps.
Thickness of plate	⅜ inch	7-16 inch.
Kind of joint	Lap	Butt.
Percentage of strength.	68.79 per cent.	85.8 per cent.
Safe working pressure, safety factor of 5	98.48 pounds	115 pounds.
Kind of metal	Steel	Steel
Heating surface, tubes	841.9 sq. ft.	1,281.8 sq. ft.
Heating surface, shell	167.6 sq. ft.	201.1 sq. ft.
Grate area	33.6 sq. ft.	49.9 sq. ft.
Type of safety valve	Ball and lever	Pop valve.
Diameter of safety valve	4⅝ inches	4½ inches.
Area of safety valve	16.8 inches	15.9 inches.
Engines.	No. 1.	No. 2.
Type	Corliss	Slide valve.
Dimension of cylinder	14x36 inches	8x10 inches.
Speed	85 rev.	325 rev.
Diameter of flywheel	10 feet	48 inches.
Width of flywheel	19 inches	9 inches.
Size of shaft	8 inches	4 inches.
Diameter steam pipe	3½ inches	2½ inches.
Diameter exhaust pipe	5 inches	3 inches.
Condensing or non-condensing	Condensing	Non-condensing.
Average load, ¼ cut-off.	100 H. P.	32 H. P.

When this is arranged in neat form and hung upon the wall in a suitable frame it is possible for any one to read, at any time, such information as they might desire regarding the plant. Another thing, it also shows that the engineer knows what there is in the plant.

Another detail that should claim the attention of the engineer is small steam leaks. It is no uncommon thing to hear engineers say they have hard work to keep up the required amount of steam, and this is doubtless so in many cases, but I will venture to say there would be less difficulty along this line if they paid more attention to leaky valves and joints in the steam pipes.

I remember an instance where the plant was piped with a system of heating which allowed either live or t steam to be used. The valves regulating the were in the engine room and connected with ipples to the logs. Some of the valves were so that it was impossible to remove the valve with the ordinary wrenches. These valves lly got to leaking and in winter time the engi- hen leaving at night would fill his boiler a good three gages, but in the morning he would nly about one gage left. He seemed at a loss erstand where his water was going to. It was i case of losing three gages of water during ght because the valves were not tight. This oss of water went on from the time the steam ut off in the spring until it was turned on again fall. It is hard to tell what these leaky valves e firm, but it was considerable in the course of

nother plant the engineer was forced to help man keep up steam, as one man could not do often the steam got down so low that the en- vould not cutoff at all. He could not see that spent a little extra time fixing up valves, of there were a large number, that there would be d of his going to the fireroom, as the fireman have had no difficulty in keeping up steam and vould soon be a difference in the coal bill.

leaky valve does not make such a great differ- ut when it comes to a large number, each leak- ttle, it can easily be seen where part of the coal

t here comes in the question of closing valves seems to be attracting attention just now in nagazine. A great many engineers seem to vhen they shut a valve it must be screwed down t as they are capable of screwing it. In some it is through ignorance and in others, ac- r to your columns, it is because the en- firmly believe in the practice. I think in many valves are spoiled because the engineer has con- a habit of using a wrench on valves that leak any new valves have started to leak because e of this kind. I maintain that a valve should only hard enough to bring the disk firmly to t, and I also believe a valve should be con- so as to shut against the pressure.

F. Wheeler.

An Oil Catastrophe.

of the Engineers' Review:

V. Raynor's contribution, "Way to Empty an -rel," in a late issue, calls to mind a laughable nce, which happened to my "side partner" a of years ago. "Billie's" indicator was the best uld be bought. No other instrument could is in accuracy. He always used a pantograph. er reducing motion was nearly so perfect. His r had the best face on it of any hammer ever out of the shop. The handle set just a little han any other handle that was ever put in. le it himself.

'Billie" had heard some one talking about oil out of a barrel by air pressure, and "Billie" ogressive. It was in the winter time, and we ing a dark heavy grade cylinder oil, which had mptied from the barrel into a tank in the cor- he compressor room.

oil was cold, and as "Billie" was in a hurry, he bored a hole in the head of the barrel, and inserted a ¾-inch pipe, on one end of which was a 1-inch bushing, which he screwed firmly into the hole, the pipe running nearly to the bottom of the barrel. A nipple in the top of the bushing made a connection for his air hose. Another hole was bored in the head and fitted with another nipple and a short piece of rubber hose running over into the tank to deliver the oil.

Connecting his air hose to the barrel and to a connection on the air line, "Billie" turned on a little air at 90 pounds pressure and run back to the barrel to watch the oil run out. He got there just in time to save a piece of the head from breaking a window, and to receive a part of over ¼ of a barrel of thick oil, in his face. As his shirts were opened in front and at the top, a gallon or two struck him in the neck and ran down inside, both front and back. A wiper heard the explosion, when the head let loose, and shut off the air, but not before "Billie" was well saturated. A large 600 horsepower electric motor near by had received a liberal coating, while the floor and walls for 10 feet around were a sight.

When "Billie" was inclined to be a little boastful in his stories thereafter, if one would ask him what he thought about emptying oil barrels with air, he would promptly find some thing to occupy his attention in another part of the room.

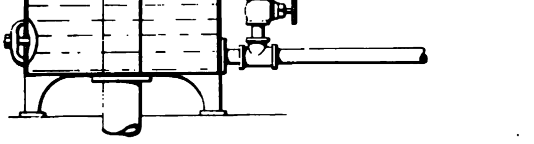
W. A. H.

[Will the writer of the above letter please forward his name and address.—Editor.]

A Feedwater Heater.

Editor of the Engineers' Review:

The illustration represents a combined closed and open heater. *A* is a low pressure safety valve, set to open at about 4 pounds gage pressure. *B* is a compound or soda feeder. As will be seen the exhaust pipe *C*, connecting to the sewer, also answers as an overflow, and will carry away much of the cylinder oil coming from the engine. In many cases it is not advisable to connect the drips and exhaust to a sewer, but in this case it was all right as the conditions existing were favorable.



COMBINED CLOSED AND OPEN HEATER.

The exhaust pipe *D*, from the engine enters the heater *E*, and connects to the tank as shown. The pump is piped from the tank by means of the pipe at the bottom of the larger heater.

Jas. E. Noble.

Engineers' Review

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SHOULD FIREMEN BE LICENSED?

At the Ohio state convention of the N. A. S. E. a petition was presented by the engineers of Cincinnati, asking the convention to take some action to prevent the passage of the license law that the firemen are trying to put through.

The only reason for such a request seemed to be a fear that if firemen were licensed, the control of boilers and auxiliaries would be taken from the engineers and that trouble would result from dividing the responsibility.

We think such a position is untenable and that the fears expressed are groundless. No sane man would hire an engineer to run his power plant and at the same time make another person responsible for the boilers.

In Massachusetts a law of this kind exists and is rigidly enforced and we have never heard of such a complaint. On the other hand such a law has many advantages. It will increase public safety. It will compel every fireman who takes the examination to procure a certain amount of education. It will ease the mind of the engineer to know that a competent person has charge of the boilers. It will increase the efficiency of the steam plant and reduce the operating expenses.

As it is at present, any man can fire a boiler if he is willing to deceive the man who hires him. No one can deny that a person ignorant of the principles of steam engineering is a menace to public safety when placed in charge of boilers.

In our opinion a law compelling a fireman to pass an examination before permitting him to operate boilers is a good one and every engineer should, as a good citizen and advocate of the progress of engineering, indorse it.

WHAT'S THE MATTER WITH THE NAVY?

The discreditable boiler explosion on the U. S. Gunboat Bennington merely accentuates the fact, well known among technical men, that our navy is weak in engineering—an indictment that, we fancy, could be more serious in one respect only, *i. e.*, that it should be found lacking in patriotism. Our naval engineers are not inferior to those of other countries in calibre and experience, nor, considering their opportunities, in technical training. It is doubtful whether under the conditions obtaining with us any nation whose mechanicians and engineers are not greater in resourcefulness—which without boasting we may fairly claim does not exist—could do as well. The fact is, we are suffering from a shortage, an increasing shortage, of engineers. The Squires law consolidating the line and the staff, which it was hoped would induce more cadets to prepare for engineering duty, has not fulfilled the expectations of its advocates; at least it has not noticeably improved the situation. The prospect is anything but reassuring, for the increase of our warships is at a rapid rate, whereas the addition of men competent to take full charge of their machinery is very slow, often a vanishing quantity. Surely, to borrow the thought of our ex-president, that which confronts us is nothing metaphysical, but a concrete, hard-as-granite fact, and a mighty serious one.

It is believed by certain philosophers that the want of opportunity to do great things is all that the average man lacks to attain fame . Whether Mr. Bonaparte, the newly chosen secretary of the navy, is of that school of opinion, we do not know, though we doubt it, but whatever his views of opportunity in the abstract it cannot be gainsaid that bigger tasks than those looming before him, tasks of great and far-reaching importance, have invited to a trial of skill few architects of government departments. Can he match them in size? We hope so, some of them at least.

What are some of these tasks? may be asked. To our mind the chief one is to reorganize out of existence the anachronisms of our naval administration, and to stop the domination of the navy by its least important and constantly diminishing side. In the opinion of its most influential personnel, shown by practice and precept, mechanical engineering is still a distinctly subordinate science in the conduct of the modern navy. In the evolution, leading on to revolution, of the ways and means of living and of the views of life which began with the coterie of mechanics who, lead by the brilliant Watt, gave to the world the steam engine, no idea based on tradition, no system supplanted by invention, has fought harder against inevitable doom than the regime of the U. S. Navy, that obtained when it was a sailing fleet, before any other than wind propulsion was known or considered practical. This spirit emulated the defects instead of the merits of the navy's peerless founder, John Paul Jones, and placed the brand of menial upon every man whose duty called him below decks. This resistance to mechanism, engineering and engineers has been as stubborn and persistent as the resistance of monarchical absolutism in Europe to modern forms of government. Such a spirit renders uncomfortable the position of the engineer, the result being avoidance of engineering studies and duties by cadets. Our navy presents the anomaly of floating machine shops operated and controlled by the office force who despise wheels and steam and grease. Seamanship, navigation, ordnance—these sciences as adjuncts to the beau and hob-nobbing arts, which with many come first, the average naval officer loves, and apparently these alone. They agree better with the combination of dandy and dignity, of kid gloves and gold lace, that is the ideal of too many.

The naval men's dislike of, and passive resistance to the encroachment of engineering with all it implies, are at once pathetic and exasperating. Old and dear traditions are of course tenacious. But it is time we recognized in the common sense way of Americans the facts of modern life. The sail, the argosy and the armada of poetry and song are of the past. Civilization, comfort, the placing of human burdens on organized iron, vitalized and made stronger than the mythical gods by heat and water, are not these of more benefit to mankind than the preservation of the obsolete and of memories of the past? This is a mechanical age. Each succeeding age will be more mechanical. It is time we woke up. Mr. Bonaparte should bend himself to securing the enactment of laws that will modernize the navy. The naval academy needs a million dollars or more for procuring modern facilities for the instruction of cadets in engineering science, and it needs even more a new faculty of mechanical engineers. The only way open at present to get competent men for our new ships is to take them from our technical schools. But no engineer of brains will long endure in our naval service the financial loss and the snobbery he must needs put up with. Congress should speedily empower the secretary of the navy to elevate to the line, with every privilege of an Annapolis graduate, the men necessary to supply our new ships, on the stocks and authorized by Congress, with competent engineers. There are plenty of them in the country.

Another thing the matter with the navy is no less intrenched. That is, its political pull. No secretary since the days of Gideon Wells has been strong enough to break the grip of naval officers on members of Congress. The Army and Navy Journal has recently spoken out strong and plain on this subject. Until Congress lends ear to the secretary of the navy instead of to the junta of naval men in Washington things will go from bad to worse. To get at the facts primarily responsible for all blundering in the navy, and especially to apply a remedy, may be set down as impossible while the pull that has kept matters in line pretty much as the admirals and captains wished for a generation, still has behind it the old time pressure.

The report made to Washington as summarized in a newspaper dispatch will be that the crown sheet of boiler *B* which so suddenly gave way was weak. This means that the stay bolts were corroded until they could not withstand the strain. A denial that too high a pressure was carried is attributed to the report. It matters not whether the disaster be considered the result of insufficient tensile strength, or excess of stress opposed to it.

Their findings exonerate the unfortunates in charge at the time of the failure, but confirm our opinion of the first and real cause—the contempt in which engineering duty is held in the navy.

Further, the servility required of enlisted men and non-commissioned officers drives from the service self-respecting Americans. They are treated as less than human.

The proudest captain of industry would not attempt to degrade his humblest workman as the midshipman fresh from the academy degrades the common sailor by his attitude.

We can not dwell longer on the subject, but if the explosion at San Diego wakes up Congress, the sixty martyrs to Russianism in the navy may not have died in vain.

SHORTAGE OF ENGINEERS IN THE NAVY.

Rear Admiral Charles W. Rae, engineer-in-chief of the navy department, points to a rather serious condition of affairs in his annual report. He practically admits that the supply of engineers is so inadequate that it is impossible to keep ships in commission and at the same time find enough men who are competent to take charge of the shore establishments. The personnel bill is practically admitted to be a failure. The engine room is not in favor. While it is essential that at least 10 per cent of the officers should perform engineering duties exclusively, not 5 per cent are available. Engineers are lacking for nearly every ship already afloat, to say nothing of those that are now building. The experiment of relying upon volunteers for the engine room appears to have been a complete failure. While Admiral Rae does not say so in so many words, he nevertheless recommends compulsory service in this department. It will scarcely be crediated, but it is none the less true that the number of engineer officers borne for service on the books is only 66, consisting of eight captains, 14 commanders and 44 lieutenant commanders. There are now no officers below this rank borne for engineering duty only. The engineering departments of the majority of the vessels of the United States navy exclusive of the heavier vessels are in charge of young line officers or of warrant machinists. It is probably practical in time of peace to get along with this small engineering staff, but in time of war a large and efficient staff is absolutely essential to the proper management of a ship.—*Exchange.*

QUESTIONS
· OF THE HOUR ·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.

The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

Notice.

On page 23 of the July issue appeared several illustrations of pipe rollers and brackets. We wish to state that they are patented and can only be obtained from the manufacturers.—Editor.

We would like the address of William S. Trafatter, as we wish to communicate with him. (Editor.)

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(443) J. B. H., Lykens, Pa. Q.—"Of what properties is graphite composed and what is there about it that cools where graphite and cylinder oil both combined will not?" A.—Graphite comes chiefly from the island of Ceylon. Ceylon graphite is so pure that for the purpose of crucible manufacture, for which it is chiefly used, it requires only proper grinding and screening. The Ticonderoga graphite, used as a lubricant, is a flake graphite disseminated through a quartz gangue. The rock is crushed and the gangue and graphite separated by mechanical and water processes. Chemically graphite is a carbon. The reason why graphite will cool a bearing or crankpin is because it is a good lubricant and prevents friction which is the cause of all heating.

(444) A. F. R., Santa Rosa, Cal. Q.—"Will you kindly publish the solution of the following: A jet condenser receives 22 pounds of exhaust steam at 3.5 pounds absolute pressure. The cooling water enters the condenser at 48 degrees F. How many pounds of water are required per hour if the temperature of the condensed steam is 130 degrees F.?" A.—The water required by a condenser is calculated by the following formula:

$$W = \frac{H - t_1 + 32}{t_1 - t_2}$$

Where t_1 = the temperature of departing condensing water.

t_2 = the temperature of the entering condensing water.

H = Total heat of vaporization of one pound of steam at exhaust pressure. This amounts to the total heat above 32 degrees.

W = Weight of water required to condense a pound of steam.

The value of H, is found approximately by subtracting 32 from the figures opposite the pressure of the steam in the steam column of the table of saturated steam showing the temperature in degrees at that pressure, and adding the figures opposite the same pressure in the column of total latent heat. Thus, for example taking an absolute pressure of 3 pounds we have a temperature of 141.654 degrees. 141.654 — 32 = 109.654. This added to the total latent heat equals 109.654 + 1,015.38 = 1,125.034, the value of H. The above formula is based upon the following rule, the water of condensation per pound of steam being found as follows: Subtract the final temperature of the condensed steam from the total heat of a pound of the exhaust steam, and then add 32; divide the result by the difference of the entering and of the departing condensing water.

Applying the above rule we have

$$W = \frac{H - t_1 - 32}{t_1 - t_2} = \frac{1,1126.88 - 130 - 32}{130 - 48} =$$

12.54 pounds of water per pound of steam. The condenser receives 22 pounds of steam per horsepower therefore the water required is 12.54 × 22 = 275.88 pounds per hour per horsepower.

(445) Same. Q.—"An engine connected to a jet condenser uses 28 pounds of steam per horsepower per hour and develops 90 indicated horsepower. The terminal pressure in the cylinder is 3 pounds absolute and the temperature of the mingled steam and water is 125 degrees F. The cooling water enters the condenser at a temperature of 60 degrees F. How much cooling water is required?" A.—This problem is practically the same as the first. Using the same formula we have

$$W = \frac{H - t_1 + 32}{t_1 - t_2} = \frac{1,125.144 - 125 + 32}{125 = 60} - 15.88$$

pounds of water per pound of steam. The engine uses 28 pounds of steam per horsepower per hour, therefore we have 15.88 × 28 = 444.64 pounds of water required. As the engine is developing 90 horsepower it will require 444.64 × 90 = 40,017.6 pounds of water per hour.

NATIONAL CONVENTION OF THE N. A. S. E.

Louisville, Ky., presented a scene of much activity from August 1 to 4, inclusive, the twenty-fourth annual convention of the N. A. S. E. being held there during that period.

On the evening of July 31 an informal reception to the delegates was held at the Seelbach Hotel, the convention headquarters, from 8 to 11 o'clock.

Tuesday morning at 10 o'clock the convention opened with the invocation by Rev. F. C. Witthoff. This was followed by an address by B. N. Grosvenor, chairman of the local convention committee. Hon. H. V. McChesney's "Welcome to Kentucky" was responded to by President Wilson, while Vice President Tomlinson answered the "Welcome to Louisville" by Hon. Paul Barth. The address of President Wilson was then given. Part of this address follows:

"In looking over the statistics of our numerical growth for a number of years, it is astonishing to note the effort made to enroll as many new associations by years as possible and with little or no regard as to whether a great many associations so instituted gave any promise of being of any benefit to themselves or to the order in general. This method of recruiting new associations caused the granting of charters to associations located in places where the chances of even a fair degree of expansion was impossible. If we may judge from the number of very small associations installed, the main thought was for new timber regardless of the permanency of its membership. Instead of this hunt for new associations, many of which, as statistics show, soon dropped from sight, the greatest care should have been bestowed in trying to strengthen the associations within the order. Assisting those within our ranks is our first duty; when that is done we can look abroad. * * *

"To those who believe that the per capita tax should be reduced, I would suggest a comparison in amounts paid in by their respective associations and the amount drawn for mileage. If the tax is lowered, so must the mileage be in like proportion. It is for those who pay in and take out to say. The question of reducing the expense of our order has occupied the time and attention of each national president for a number of years. The most feasible means of accomplishing such a noteworthy reform seems to lay in one or two directions. The first is for holding the national convention every two years, instead of each year as at present. The second is by placing the state associations in authority in the different states, with the subordinate associations represented by delegates to the yearly state convention and the latter to elect delegates to the biennial national convention. Either of the methods suggested have their good points. A number of members who have given considerable thought to the biennial convention seem to fear that the enthusiasm which prevails at our annual gatherings and lasts until the following year would hardly last over a period of two years. From the standpoint of enthusiasm, such views may be correct; but the convention brings together less than 4 per cent of our membership who may enthuse, as against the great majority who remain at home."

In concluding the president made the following recommendations:

1. "That the board of trustees be instructed to discontinue publishing the directory of subordinate associations in the National Engineer.

2. "That the national secretary be instructed to have printed, semi-annually, the directory of subordinate associations, and to mail a copy of same to each association with tax receipt; also to such individual members as the national president may direct.

3. "That a committee be appointed to draw up an entire new constitution containing only the fundamental laws for our government.

ROYAL D. TOMLINSON, NATIONAL PRESIDENT N. A. S. E.

T. N. KELSEY, NATIONAL VICE PRESIDENT N. A. S. E.

4. "That the recommendations of the License Committee be approved.

5. "That the recommdneations of the Committee on Standardization be approved."

The Credentials Committees reported the attendance of 350 delegates and 42 alternates. In addition to this there were 31 guests, and 149 members of the Supply Men's Association registered.

On motion, a Committee on Analysis and Distribution was then appointed.

The treasurer's report showed that the complete receipts for the past year were $23,171.98, of which $6,328.57 was paid out, leaving a balance of $16,843.41.

The Home Committee reported that they believed that by beginning in a small way a home could be established by an expenditure of from $8,000 to $10,000, to be raised either by voluntary contributions from the subordinate associations or a per capita tax of 50 cents per member per year until the amount necessary be raised. The committee feared that the establishing of such a home would cause many engineers who are sick or disabled to enter the association in order to enjoy this advantage. To prevent this they thought it fair that only such members as have belonged to the association 10 years be eligible to admittance to the home.

They stated that a number of wealthy men were willing to assist in founding the home as soon as some definite plan has been adopted. The National Ladies' Auxiliary have $1,000 in their treasury that will be turned over to the N. A. S. E. for this purpose when the proper time comes.

The Committee on Standardization's recommendations were:

1. "The formation of a joint committee from the manufacturers, American Society of Mechanical Engineers and American Institute of Electrical Engineers and the N. A. S. E., to revise and adopt a joint standard.
2. "The adoption of a standard for pipe fittings with a standard weight and size for pressures of 100, 150 and 250 pounds.
3. "The adoption of a standard speed and size of cylinders for engines for a given work, for both high and slow speed engines.
4. "The adoption of a standard size in kilowatt output, speed, overload capacity and temperature rise of generators, and the same condition to apply to motors.
5. "That the members in making their requisitions call for standard sizes, and from time to time inform future committees on this work; and the variations from standard that they find in material purchased."

The Committee on Education presented a very satisfactory report. In the contest, which covered a period of seven months, about 200 associations participated. The first prize of $50 was awarded the New York No. 15, of Long Island city. Massachusetts, No. 9, of Milford, captured the second prize, $25, while the third prize, $15, was taken by Illinois No. 17, of Moline.

The secretary announced that on Thursday morning at 11 o'clock memorial services for departed brothers would take place.

The secretary reported that 14 new associations, with a membership of 2888, had been formed. The total membership of the National Association including honorary and associate members in good standing is 17,928 while those suspended number 446.

In the evening a vaudeville show was given in the Masonic Temple theater. This was well attended and much appreciated.

On Wednesday most of the delegates visited Mammoth Cave, the trip requiring the whole day. Although there was a crowd and the journey somewhat tedious, it was reported to be worth the trouble and discomfort experienced in getting there and back again.

Thursday morning at 9 o'clock the business of the convention was continued. A committee was appointed to confer with the Ladies' Auxiliary in order to adopt some plan for raising a Home Fund.

After a somewhat lengthy report the Committee on License Legislation presented the recommendations which follow:

1. "That the incoming national president be requested to direct the national license committee to compile a list of all laws in this country, pertaining to the examination and licensing of stationary engineers. That said license committee shall prepare such compilation for printing in substantial book form, properly indexed; and that such compilation shall be accompanied by a report of the national license committee, embodying its views on the various phases that enter into the framing of license bills, and the securing of their enactment.
2. "That the national president be authorized to expend an amount of money sufficient to carry out the intent of the previous recommendation.
3. "That the compilation and accompanying report of the national license committee, after being printed and in book form, shall be turned over to the custody of the national secretary for such distribution as the national president may direct."

The reports of other committees were duly delivered, but we present only the most important ones. Details of the convention will be published in the National Engineer the official organ of the association.

The convention will be held at Philadelphia in 1906, the time of meeting having been changed to the second Tuesday of September.

The committee on Analysis and Distribution reported the following action on the president's recommendations: Nos. 1, 2 and 3, defeated. No. 4 referred to the Ways and Means Committee. Nos. 5, 6 and 7, referring to Standardization Committee's recommendations, adopted.

At 2:30 p. m. the visiting ladies were given a trolley ride.

A ball was given Thursday evening and about 80 couples took part in the grand march.

On Friday the election of officers took place. Vice President Tomlinson was elected president for the coming year. T. N. Kelsey was elected vice president. Fred W. Raven was reelected secretary and Hugh Rensford reelected treasurer. Chas. H. Garlick was again elected a member of the board of trustees of the National Engineer for five years and J. H. Van Arsdale was elected to fill the unexpired term of Jos. Carney, who had resigned. The conductor for next year is B. N. Grosvenor and Wm. Speck is doorkeeper. Past President Wilson was presented with a past presidents' jewel. Herbert Stone made the presentation speech on behalf of the whole association.

The new officers were then installed.

On learning that the Hon. Wm. Jennings Bryan was in the city, the president upon motion, appointed a committee to wait upon Mr. Bryan and request him to address the delegates in the afternoon. He accepted and at 2:30 the hall was filled with an enthusiastic audience. After his speech and a song by a delegate from the South, the convention closed.

The convention was held in the Scottish Rite Cathedral.

Friday morning at 10 o'clock the Supply Men's

ociation met and after transacting a little busi-
s elected officers for the ensuing year. J. D.
es, of the International Correspondence Schools,
nerly secretary, was elected president; Jno. A.
son of A. W. Chesterton & Co., vice president;
. McGilvray, Peerless Rubber Mfg. Co., secre-
,and H. F. Weinland, Lagonda Mfg. Co., treas-
r. The executive committee consists of Geo. B.
Tassel, Under-Feed Stoker Co., Herbert E.
ne, Chapman Valve Co., and Fred L. Jahn, Wat-
-McDaniel Co.

harles Martin in an appropriate speech pre-
ted retiring president C. M. Eddy with a cut
s wine set, as a token of the association's appre-
ion of Mr. Eddy's services.

A GOOD PACKING.

packing a stuffing-box, as much or more depends
he quality of the packing used, as on the skill and
displayed by the engineer. A good packing must
up easily, so that too much compression is not
led to make it tight. There must be a certain re-
e of elasticity, as it wears or settles into its place.
ndall packing, made by the Crandall Packing Co.,
nyra, N. Y., is a typically "good" packing. It has
necessary resiliency, the wearing surface is a cov-
of braided long-fibre flax, impregnated, by a
oil process, with a lubricant, which not only in-
ses its wear resisting capacity, but obviates the
ion inseparable from a tightly set up packing.
ineers who have used the Crandall packing, com-
d it highly for its resiliency, anti-friction effect
great durability.

SWARTWOUT EXHAUST HEAD AND STEAM SEPARATOR.

e illustration in Fig. 1 is made from a photo-
h of a 16-inch Swartwout cast iron exhaust

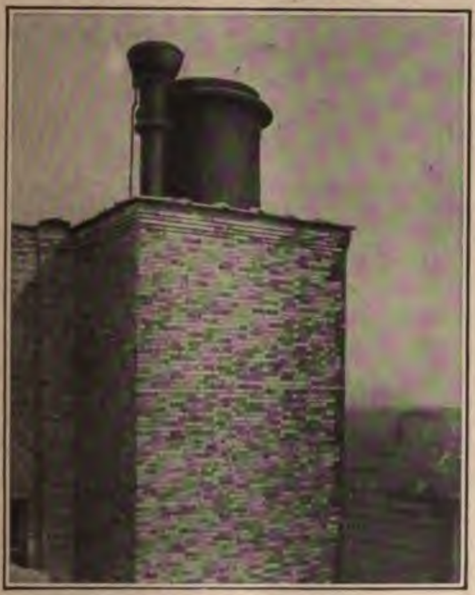


FIG. 1. EXHAUST HEAD.

on the Columbus Savings & Trust Company's
ory office building, Columbus, Ohio.

It can be placed in any location and unlike the galvanized head, is indestructible and impervious to soot and gases. Being made of cast iron, it will last a lifetime, yet it is as light in weight as a good galvanized iron head. This head appeals to architects and engineers on account of its simplicity and ornamental appearance.

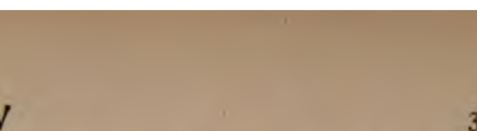


FIG. 2. STEAM SEPARATOR.

The Swartwout steam separator, like the exhaust head, is of the greatest simplicity. It is placed above the throttle valve, and having a large reservoir, insures a high initial velocity.

All separators are guaranteed to 150 pounds pressure and sent on trial.

Full information, catalog and prices of these devices can be obtained from The Ohio Blower Co., sole licensees and manufacturers, 43 Michigan street, Cleveland, Ohio.

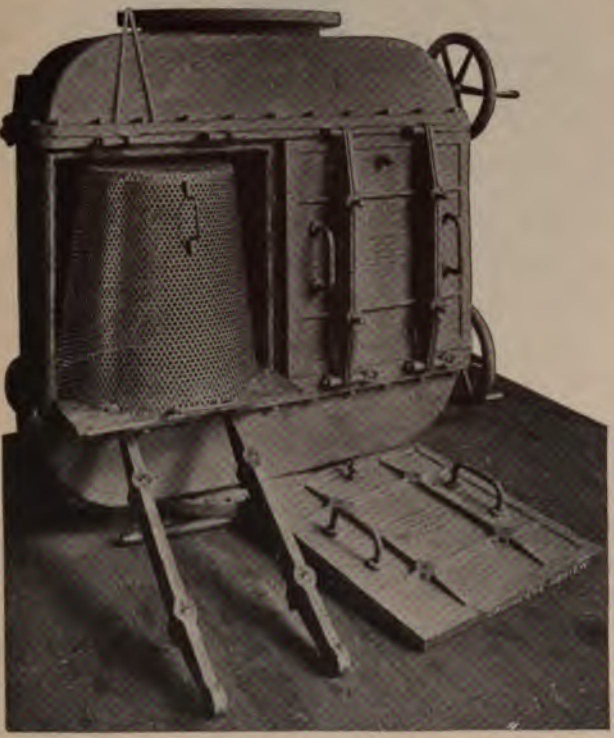
IDEAL TWIN SUCTION STRAINER.

An essential appliance for high grade steam plants recently placed on the market, and which is coming rapidly to the front, is the Merrill Ideal twin suction strainer or fish trap. This provides a very efficient device for catching all refuse that may be in the water used for condensing or boiler feeding, and also furnishing an easy and quick means for the removal of the refuse without even interrupting the flow of the water.

The strainer instead of being placed on the end of the suction pipe, is placed next to the pump or condenser in the engine, or pump room, wherever most convenient. Only one strainer is used at a time, and when it becomes filled with refuse, it is shut off by means of the hand wheels shown, which operation diverts the water through the other strainer, which is used until it needs cleaning and then the operation is reversed. Thus the flow of the water is not interfered with in changing from one strainer to the other, or in cleaning either strainer which can be done as often as required.

The maximum vacuum can be maintained at all times, which is so essential on steam turbines in order to maintain their economy. It also effectually does away with the necessity of removing the heads of surface condensers to clean out the tubes, or taking out the cones of condensers of the Buckley type, to clean out leaves or sticks, which so often lodge in the small annuler opening around the cone and impair the vacuum. Another application recently made with this device is for the suction of fire pumps so that in case of fire, no time is lost by having anything get under the pump valve, thus decreasing its efficiency.

The one herein illustrated is a 20-inch strainer which was recently shipped to the Syracuse Lighting Co., of Syracuse, N. Y.



IDEAL TWIN STRAINER.

This device was designed and patented by Mr. G. U. Merrill, 31 Van Houten street, Paterson, N. J., who is placing them on the market and reports the outlook for their sale very encouraging. Any further information desired can be obtained by writing him at the above address.

NOTES FROM THE NATIONAL CONVENTION.

The following companies, members of the National Supply Men's Association, had booths and goods on exhibit in Liederkranz Hall. Many souvenirs, some of value and others purely novel, were distributed among the delegates and guests.

The Buckeye Engine Co., Salem, O., were represented by Mr. C. H. Weeks, who was kept busy distributing carnations and roses to all who gave their names and addresses.

The Geo. W. Lord Co., Philadelphia, distributed fans and literature. Mr. Edwin McCarthy of the Pittsburg district assisted by Lyman P. Clark, C. E. of Philadelphia, received old friends and made new ones for their company.

The Quaker City Rubber Co., Philadelphia, Mr. A. D. Thompson, representative, did not occupy a very favorable position, but were visited by the friends of P. P. P.

The Indicator Instruction Co., Scranton, Pa., exhibited their indicating outfits and Messrs. Mistele and Hollister explained the instruction plan to all who inquired.

Adam Cook's Sons, New York, manufacturers of Albany grease had an attractive booth in charge of G. E. Tanberg, who was almost too busy to eat. A neat penwiper and calendar were the souvenirs.

The Fisher Governor Co., Marshalltown, Ia., were ably represented by their president, Mr. Wm. Fisher. In order to make every one feel at home, Mrs. Fisher assisted him at receiving. A handsome leather covered memorandum book was presented with the company's compliments. It was so popular that the supply was soon exhausted and more were ordered.

Greene, Tweed & Co., New York, distributed samples of Palmetto packing. Mr. H. S. Demarest and B. W. Ham were busy all day long.

The Stayman Manufacturing Co., New York, manufacturers of self-expanding pistons and piston valves and vibrating metallic rod packing, were represented by C. A. Weymouth, president and J. Alvah Scott, C. E.

The Lagonda Mfg. Co., Springfield, O., exhibited a full line of the Weinland cleaners and other specialties. They were represented by H. F. Weinland, Robert Gregory and J. B. Davidson.

Ahrens & Ott Mfg. Co., Louisville, Ky., sales agents for Ruggles & Ruggles, Batavia, Ill., the American Pulley Co., Philadelphia, and others, were represented by W. E. Edinger. He was assisted by C. M. Ruggles of Ruggles & Ruggles and J. M. Wood of the American Pulley Co.

The Lunkenheimer Co., Cincinnati, had a handsome display of their specialties and were represented by Sam Moyer, W. Schmidt, Jr., A. W. Dodds and C. K. Thomas.

The Cling Surface Co., Buffalo, N. Y., demonstrated the practical use to which Cling Surface can be put. Mr. Wm. Young, secretary of the company had charge of the exhibit.

Jas. L. Robertson & Sons, New York, had a booth, and pictures of the Eureka girl and a bill hook were given away.

The V. D. Anderson Co., Cleveland, represented by Jas. H. Meyers, distributed a useful, though small, bound book. It contains much information of value.

The Crandall Packing Co., Palmyra, N. Y., had an attractive exhibit and distributed samples of Crandall packing. Mr. Sam Hildreth, manager, looked after their interests.

The Wm. Powell Co., Cincinnati, C. E. McFarlan, representative, gave away hundreds of the White Star souvenirs.

The Peerless Rubber Co., New York, were represented by J. L. McGilvray, P. G. Staunton and Chas. Garlick, Jr. The many friends of Rainbow packing kept all hands busy.

The Under Feed Stoker Co., Chicago were represented by Geo. D. B. Van Tassel and Wm. T. Johnson. They made everyone happy with their souvenir pocket mirrors and contagious smiles.

The Pennsylvania Metallic Packing Co., Pittsburg, Pa., represented by Tommy Green, made quite a hit with the fanobromo-tone, a noise maker, which they distributed.

The Home Rubber Co., Trenton, N. J., A. R. Foley, representative, distributed a stick pin which proved very popular. The head of the pin was an almost perfect imitation of a fly.

The C. Lee Cook Co., Louisville, Ky., were represented by their genial secretary, Robt. C. Baldwin. This company manufacture Cook's metallic packing which was used in the subway.

The International Correspondence Schools, Scranton, Pa., were represented by J. D. Jones, J. J. Hurley and M. M. Sizemore.

Jenkins Bros., New York, were represented by Messrs. Martin, Waite, Bulkley and Langston.

Dearborn Drug and Chemical Works, Chicago, gave away several different souvenirs. Messrs. Eddy, Eardley, Wheeler, Hogan, Beckerleg, Schatz and Clark looked after their interests.

The State Mfg. Co., Cleveland, O., manufacturers of Metla-Cota, a boiler cleaner, gave a handsome watch fob to all who registered. Mr. J. C. McDonald was in charge.

The H. W. Johns-Manville Co., of New York and Milwaukee, had a display of their Kearsage packing and absetos specialties. They called special attention to Transite and Manderite fire proof lumber which they manufacture. W. F. Taylor and C. E. Wehr represented them.

The Vellumoid Paper Co., Worcester, Mass., manufacturers of sheet packings, gaskets, etc., were represented by A. D. Putman.

The Kent Lubricating Co., Waukesha, Wis., represented by

L. H. West, had a display of different sized cans of Kent lubricating compound.

The Atlas Engine Works, Indianapolis, Ind., were represented by Messrs. Moore, Bechtel and Keegan.

A. S. Cameron Steam Pump Works, New York, had a display, but no representative.

Westinghouse Air Brake Co. and Westinghouse Traction Brake Co.'s interests were looked after by S. D. Hutchins, assisted by W. S. Clark.

A. W. Chesterton & Co., Boston, Mass., had a display of their packings. The booth was in the charge of J. A. Carson and W. M. Rea.

Roebling Sons Co., Trenton, N. J., gave away endless wire watch charms and cigars to the men and candy to the ladies. W. W. Affleck and W. C. Henning represented them. They have more of these charms and will send one to any engineer who addresses them at the home office or at Cleveland.

McLeod & Henry Co., Troy, N. Y., manufacturers of steel mixture boiler door arches were represented by Mr. John Foote.

Manzel Bros., Buffalo, had their friends looked after by H. J. Manzel, C. R. Isch and I. P. Hubson.

Ashton Valve Co., Boston, had two representatives, both well known, Columbus Dill and Harry Ashton.

Chapman Valve Mfg. Co., Indian Orchard, Mass., represented by Robt. E. Stone.

Liberty Mfg. Co., Pittsburg, Pa., represented by J. B. Pell and J. J. Connelley.

Watson & McDaniel Co., Philadelphia, represented by F. L. Jahn.

Jos. Clark, Jr. & Co., Louisville, Ky., represented by F. F. Fleming, distributed Starrett steel foot rules.

Howe Mfg. Co., Louisville, Ky., manufacturers of the Howe valve were represented by Ben Howe, president, and F. W. Jefferson, secretary and treasurer.

Garlock Packing Co., Palmyra, N. Y., were represented by Messrs. Hibbard, Chapman, Wells, Simonds, Hadcock and Danley.

Revere Rubber Co., Boston, were represented by H. E. Nicholson.

A. J. Sorge & Co., Western agents of the Harrison Safety Boiler Works, of Philadelphia, distributed printed matter on Cochrane heaters and separators.

The Engineers' Review was represented by J. Willett Smith, Eastern advertising manager and A. E. Warner, business manager. Mr. R. D. Tomlinson, the new president of the N. A. S. E. stopped at our booth for a chat and to hand in his subscription.

Other manufacturing concerns with exhibits were: Fairbanks, Morse & Co., Laib & Co., jobbers, Louisville, Ky.; Star Asbestos Mfg. Co., New York; Advance Pump & Compressor Co., Battle Creek, Mich.; J. J. Reilly Mfg. Co., Louisville, Ky.; Power Specialty Co., Detroit, Mich.; Armour & Co., Chicago; Strong, Carlisle & Hammond, Cleveland; Gunther-Wright Machine Co., Owensboro, Ky.; Norwall Mfg. Co., Chicago; A. C. Clark & Co., Chicago; Mason Regulator Co., Boston, Mass., represented by F. A. Morrison; New York Belting & Packing Co., represented by their local agent, W. G. Neil, Leschen & Sons Rope Co., St. Louis; Jos. T. Ryerson, Chicago.

Besides the Engineers' Review, other publications represented were Power, New York; National Engineer, Chicago; and the Engineer, Chicago.

The following concerns contributed to the Supply Men's Association but had no exhibit: Jas. Bonar & Co., Walworth Mfg. Co., Manning, Maxwell & Moore, Keystone Lubricating Co., Standard Oil Co., Crane Co., Babcock & Wilcox Co., Hartford Steam Boiler Insp. & Ins. Co., American Steam Gage & Mfg. Co., Chandler & Taylor Co., Valvoline Oil Co., D. T. Williams Valve Co., Republic Rubber Co., Gallagher & Speck; Randolph Brandt, Empire State Eng. Co., Loew Supply & Mfg. Co. and Goodyear Tire & Rubber Co.

NEW BOOKS AND CATALOGS.

A COMPLETE DESCRIPTION of the "Goodyear"-Akron metallic packing is furnished in an attractive little booklet recently published by the Goodyear Tire & Rubber Co., of Akron, O. This booklet will be sent on application to any interested party.

THE KENT LUBRICATING CO., Waukesha, Wis., have issued an attractive booklet which sets forth the good advantages of Kent lubricating compounds.

THE PUBLICITY MAGAZINE for August, published by the Under-Feed Stoker Co., Marquette building, Chicago, is out and contains a list of recent sales and installations which they have made of their famous Jones stoker.

ONE OF THE HANDSOMEST catalogs that has come to our attention is that recently received from the American Engine Co., 64 Raritan avenue, Bound Brook, N. J. The catalog has a heavy embossed cover and the contents are printed on coated book paper. It contains descriptions and much useful information concerning their latest Ball engines, both simple and compound. It would make a very nice addition to any engineer's library and a copy will be furnished free upon request.

A METAL POLISH that will clean every thing in the polished metal line is manufactured by George William Hoffman, 295 East Washington street, Indianapolis, Ind., and is described in a dodger recently received. He will send a trial sample to any one interested on the receipt of a two-cent stamp, if the Engineers' Review is mentioned.

MASON STEAM REGULATING DEVICES and steam pumps are described in an attractive little catalog issued by the Mason Regulator Co., 158 Summer street, Boston, Mass.

A BOOKLET WITH a sample of sheet packing enclosed is being sent out by the Vellumoid Paper Co., Worcester, Mass., who manufacture Vellumoid sheet packing and cut gaskets.

THE LEE NOISELESS exhaust pipe head is illustrated in a price list sheet issued by Thomas Lee, 128-132 Second street, Cincinnati, O.

"A TIME SAVER" is the title of a little folder describing the favorite reversable ratchet wrench which is manufactured by Greene, Tweed & Co., 17 Murray street, New York, N. Y. This price list and folder free upon request.

PAMPHLET NUMBER TWO has been issued by the Star Asbestos Mfg. Co., 56 Fulton street, New York, N. Y. This contains much of interest in regard to their high pressure packings.

A NEW PREPARATION for cleansing steam boilers which is called Metla-Cota is described in a neat little booklet which is being issued by the State Mfg. Co., 38 Michigan street, Cleveland, O. A complete description of the process and catalog will be sent upon request by mentioning the Engineers' Review.

COOK'S METALLIC PACKING can be used without an oil cup and 40,000 sets of it are at present being used in this condition. Other facts and testimonials are included in their latest catalog which can be had by addressing C. Lee Cook, Louisville, Ky.

STAYMAN SPECIALTIES are described in a series of several book coated dodgers which are being mailed together by the Stayman Mfg. Co., 143 Liberty street, New York, N. Y.

TRADE NOTES.

JAMES McCREA & CO., Chicago, manufacturers of the Climax steam joint clamp for repairing leaks where pipes are screwed into fittings and the Emergency pipe clamp for repairing splits and rust-holes on pipes, have just applied for a patent for a novel device in the way of a clamp for stopping leaks between pipe flanges. Every engineer has experienced times when leaks of this kind occurred and it was impossible to shut down to renew packings, or when the flanges were in some inaccessible place where they could not be packed without great expense and trouble. Patterns to fit all diameters of flanges are now under way and we hope to have sufficient information for an illustrated article showing this new invention in our next issue.

MODEL STOKER CO., Dayton, O., were represented at the National convention of the N. A. S. E. by Adam Cole, past president of the Ohio association.

THE MOUND TOOL & SCRAPER CO., 710-712 Howard street, St. Louis, Mo., offer to all engineers who mention that they have seen the advertisement of the Mound tools in the columns of the Engineers' Review a souvenir packing tool free of charge. The offer holds good for this month only, so that engineers should take advantage of it at once.

THE CHANDLER & TAYLOR CO., Indianapolis, Ind., report that they have recently secured contracts for the enclosed self-oiling direct connected engines in the following institutions: Purdue University, Lafayette, Ind; main power plant Indiana State Normal School at Terre Haute, Ind.;

Girls' Industrial School, Indianapolis, Ind., two units; Michigan College of Mines, Houghton, Mich. These are all engines built exactly in accordance with the recommendations of the American Society of Mechanical Engineers and American Institute of Electrical Engineers for direct connected units.

THE LIPPINCOTT STEAM SPECIALTY CO., Newark, N. J., who have for months been trying to catch up with orders have at last succeeded and are now ready for new business. The Indicator Instruction Co., of the same city, have completed their course and will be pleased to communicate with any engineer who wishes to know their plan of instruction.

IT IS SAID that the longer an engineer uses Albany grease the more convinced he becomes that it is truly a panacea for all lubrication troubles. Messrs. Adam Cook's Sons, 313 West street, New York city, the only makers, have received a letter from L. L. Moses, chief engineer of the U. S. hydraulic dredge, Jacksonville, which is of decided interest in this connection, and reads, "I am a regular user of your product, and have always had the best of success with it. I am chief engineer of the U. S. hydraulic dredge, "Jacksonville," working on St. Johns river, Florida, and both of my assistant engineers, as well as myself, swear by Albany grease. We use it on main engine and all auxiliaries, and as we have thirty-three (33) steam cylinders, we have ample opportunity to watch its work under different conditions. Am at present home on leave of absence, but I left the boys a plentiful supply of Albany grease."

THE ROCK ISLAND ARSENAL at Rock Island, Ill., has recently purchased a large oil filter from the Burt Mfg. Co., of Akron, O. This well-known firm not only supplies the U. S. government with their products, but does an extensive business abroad. Besides shipping two of their 8-inch exhaust heads, for the use of the government at Seattle, Wash., they have recently made a shipment of 10 exhaust heads and nine oil filters to supply their English trade. They also report the sale of three oil filters to their agency at Calcutta, India.

THE D. T. WILLIAMS VALVE CO., Cincinnati, O., announce that they have just made arrangements for the exclusive manufacture and sale of the Cookson trap and separator, formerly manufactured by the Cookson Steam Specialty Co. They have purchased the patents, patterns and good will of Thomas J. Cookson and the exclusive right to manufacture his specialties. They will be glad to correspond with interested parties.

SALESMAN WANTED.

Specialty Salesman Wanted: One with connection among steam users and industrial plants. State experience and references. A. M. C., in care of Engineers' Review.

ENGINEERS LICENSE—Engineers, electricians, firemen and machinists send for 52 page pamphlet, describing Spangenberg's Steam & Electrical Engineering, just out; best book ever published, sent FREE. Geo. A. Zeller Book Co., No. 26 S. 4th. St., St. Louis, Mo.

ENGINEER'S LICENSE

"THE HAWKINS' WORKS"

are the most helpful series of books published for **Engineers and Firemen**, relating to a safe and sure preparation for examination for Engineer's licenses and promotions.

Complete Catalogue sent free, write to-day.

THEO. AUDEL & CO.
63 Fifth Ave., New York City.

Here's a Letter, Mr. Engineer, Which Knocks "The Damage to Tube Theory" Sky High.

THIS IS THE DEAN BOILER TUBE CLEANER

For Water Tube Boilers.

For Return Tubular Boilers.

Some of the engineers think that the Dean Boiler Tube Cleaner damages tubes, for after use a few leaky ends have shown themselves.

July 8, 1905.

READ THIS LETTER, PLEASE.

The Wm. B. Pierce Co.,
325 Washington St., Buffalo, N. Y.

Dear Sirs: We have used your Dean Boiler Tube Cleaner in taking the scale from our four water tube boilers. The scale was quite hard, and we found your Cleaner the best type to remove the scale of that kind, than any thing that we have tried or seen. It did the work very satisfactorily, and so far as we have seen without injury to the tubes.

Yours truly,
SESSIONS FOUNDRY Co., By J. T. Chidsey.

The Dean Cleaner in the hands of a competent engineer has never yet injured a boiler tube.

It has, however, disclosed tubes which have been burnt out around the header and were only held in place by scale—So when the scale was removed a leaky tube was the result.

No fair minded man should ever blame the Cleaner for showing up such a defect, for in many cases the existing defects brought to light by this Cleaner have been such that if allowed to pass unnoticed, would have resulted in an explosion.

That every engineer may know the merit of this Cleaner, we will loan one for trial in one boiler.

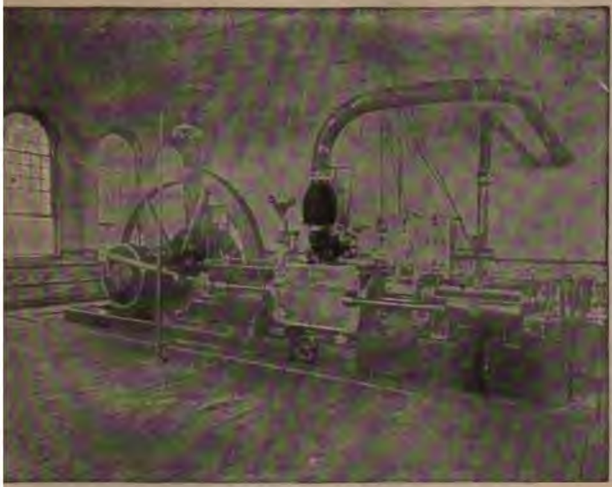
It not only removes all scale from both sides of the tube, but shows the true condition of your boiler tubes.

Our book "Boiler Room Economy" tells all about the Dean Cleaner—all about boiler scale—all about our trial offer. Send for it today.

Incidentally we might mention that there are over 5,000 Dean Cleaners in use—including such concerns as the United States Steel Corporation which used over 100; Standard Oil Co., over 40; United States Leather Co., over 50.

60 per cent. of the sales of this Cleaner are made after trial. We'll be glad to loan you a Cleaner NOW. In writing please mention size of tubes, and type of boilers.

THE WM. B. PIERCE CO.
325 Washington Street,
Buffalo, N. Y.



THE LAST CHANCE

to take water out of Live Steam is at the throttle. We make several styles of

AUSTIN Steam Separators

designed to be installed as shown above, giving

Three Great Advantages

DRY STEAM — Increased efficiency in the engine. Over 99.5% dry steam proven by test.

STEAM STORAGE—Extra steam instantly available for sudden increases of load. In many plants the use of a steam separator that also acts as an accumulator is invaluable.

ENGINE INSURANCE—A large Austin receiver separator properly drained—for this purpose use a good steam trap—gives absolute protection against water entering the engine cylinder either in large or small amounts.

Fig. "H" Vertical

Figured in any of these three ways an Austin Separator earns steady dividends on its cost. And we let you prove it to your own satisfaction before a cent of money changes hands. Catalogue illustrates and details the complete Austin line of separators for live or exhaust steam. *SEND FOR IT.*

Austin Separator Co.

90 Woodbridge St., Detroit, Mich., U. S. A.

This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

IF YOU COULD BE INDUCED TO PLACE AN **L. & D. Self-Cleaning Foot Valve** ON YOUR BOILER FEED PIPE YOU WOULD NEVER TAKE IT OFF.

It costs comparatively nothing because of its simplicity and because no expensive parts are required. It is well made, strong and always efficient. With this valve no crib or settling basin is needed. The spring can be set to hold the water in the suction pipe no matter how great the lift, keeping it always primed. Can be easily and quickly attached. Get our circular and price list.

L. & D. FOOT VALVE CO.
353 S. FRONT ST. GRAND RAPIDS, MICH.

YOU CAN KEEP YOUR BOILERS CLEAN

easily by our method. We know that there are fake compounds on the market, but don't condemn

International Boiler Compound

until you have given it a fair trial. We have a surprise in store for you if you doubt its efficiency. We want you to try it and we have a special offer for engineers. Write us today. We guarantee it.

International Boiler Compound Co.
47 Market Street, CHICAGO, ILL.

THE USE OF THE

Reliance Safety Water Column

INSURES AMONG OTHER THINGS

Steady Water	Less Repairs
Steady Power	Less Stoppages
Steady Steam Pressure	Less Fuel

Less Expansion and Contraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

Write us for further information.

The Reliance Gauge Column Co.

86 E. Prospect Street CLEVELAND, O.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.

Albany, N. Y., U. S. A.

Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

The Standard Steam Trap of America

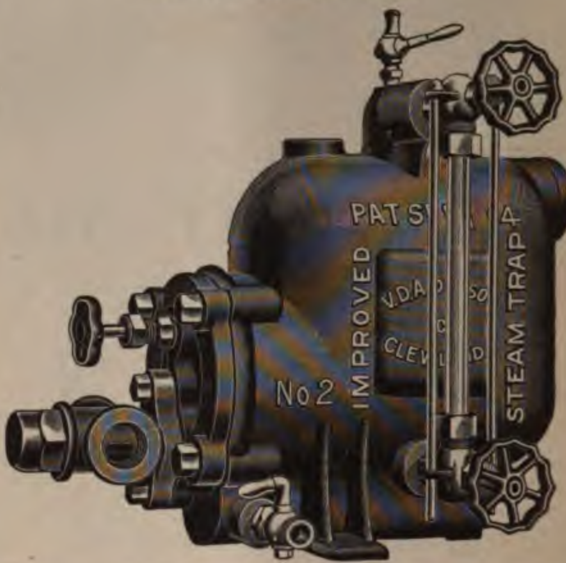
IS THE

ANDERSON

MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.



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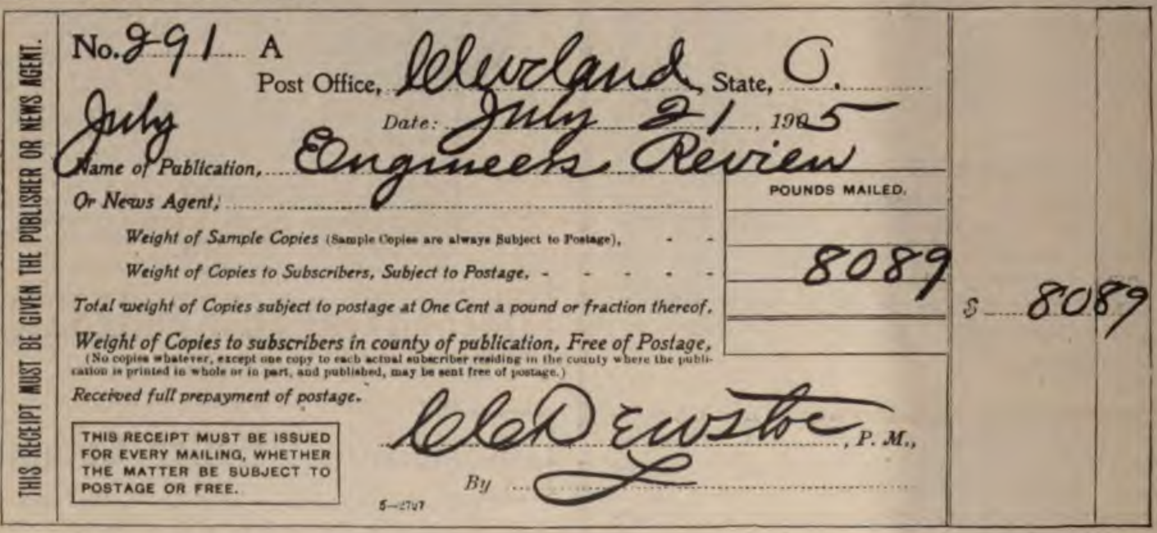

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No. 891 A

Post Office, Cleveland State, O.

July Date: July 21, 1905

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Or News Agent;

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C. C. Dewstoe, P. M.,

By

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Total number of pounds for July issue	8,089 pounds
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One copy of July issue weighs 6¼ ounces, making a total number, mailed by the pound rate, of	20,362 copies
Copies mailed in Cleveland under stamps 200 and 538 delivered to our office make an addition of	738 copies
The total edition for July being	21,100 copies

SENT FREE to Any User of Pipe Wrenches

who will write us, answering the following enquiries, one

"TRIMO" Bull Dog Chain Wrench
(MADE OF STEEL)

in miniature—same as this cut, 6 inches long, taking 3-8 inch pipe.

This offer is good only to the first two hundred who write us.

Do you use "TRIMO" Pipe or "Bull Dog" Chain Wrenches, or "TRIMO" Pipe Cutters? If so, do they give you perfect satisfaction? Or do you use other makes in preference?

Write us at once on your own letterhead or billhead. Let us also send you FREE Catalogue No. 22.

TRIMONT MANUFACTURING CO.
9 to 39 Armory Avenue, Dept. C **ROXBURY, MASS.**

TRIMONT MFG. CO. ROXBURY MASS.

STEAM PIPES THAT SPATTER ROOFS

Does this suggest a condition that exists in your own plant? A constant drizzle of oil and water from the exhaust pipe. Decay of roof. Spattered walls. Wet sidewalks. Annoyance to passersby and injury to their clothes.

A Wright "CYCLONE" Exhaust Head
Would Stop All This!

The "CYCLONE" is a perfectly proportioned head. Extremely heavy and durable, and made to last for years. It cannot cause back pressure, all steam passages being ample, giving a full, free course to the steam, which issues light and dry and without noise.

Don't buy an exhaust head until you have studied the construction details of the WRIGHT "CYCLONE" **Send for leaflet.**

WRIGHT MANUFACTURING CO.
82 Woodbridge St. - - - **DETROIT, MICH., U. S. A.**

The Best Way

to remove dirt and grit from your lubricating oil is to run it through a Cross Oil Filter. The Cross strains it through waste, then washes it in pure, warm water—all impurities are thus positively separated from it, and it can be used again and again. Practically no attention is required after the filter is started, and the first cost is the only expense, except a few cents per year for waste. The Cross Filter cannot clog up, and there is nothing about it to break or get out of order. Its use in your shop means money in your pocket—shall we send the catalog?

The Only Way

to positively remove water and oil from your exhaust steam lines is to install a Burt Exhaust Head on the top of your exhaust pipe. It contains no baffle-plates, no diaphragm, no scrap metal. It is built from extra heavy iron, lapped, riveted and soldered—no stronger construction is possible.

Its use prevents drenching and rotting of the roof—it prevents icy sidewalks, and the damage suits which are sure to result from them. The fact that 44 are in use by the Baldwin Locomotive Works, and 75 by the U. S. Steel Corporation, ought to be sufficient proof of its excellence. We have just issued a new 48-page catalogue—the finest ever issued by any oil filter concern and will be glad to send a copy upon request.

THE BURT MANUFACTURING CO.

Largest Manufacturers of Oil Filters in the World.

232 Main Street, AKRON, OHIO, U. S. A.

Also Supplied by Engine Builders, Dealers and Power Contractors.

This Trade mark on every package

There is only ONE ALBANY GREASE

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Can be used in every style of grease cup made, which cannot be done with *any other* lubricant.

Cost of using Oils

Cost of using ALBANY GREASE

Buying Lubricants and Supplies on prices without considering quality is not good judgment, it does not pay. We will give you the benefit of our years of experience.

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

ADAM COOK'S SONS,
313 West Street, NEW YORK CITY, U. S. A.

Genuine Armstrong
STOCKS AND DIES

FOR THREADING PIPE.

Universally acknowledged to be the best on the market.

The Armstrong Mfg. Co.
Bridgeport, Conn.
New York Office,
139 Centre Street.
Send for Catalogue.

ARMSTRONG MANF'G. CO.
WATER GAS AND
STEAM FITTERS TOOLS
BRIDGEPORT CONN.

MOUND PACKING TOOLS

Will go in any valve, rod, pump or engine stuffing box. Will withstand roughest usage.

1 set of 4 Locking Tools.....$1.50
1 set of 6 Packing Tools..... 2.25
1 set of 5 Cold Chisels..... 2.00

Mail orders promptly attended to. Get our book Engineers' Chums.

MOUND TOOL & SCRAPER CO., 710-712 Howard St., ST. LOUIS, MO.

CRANE VALVES
ESTABLISHED 1855

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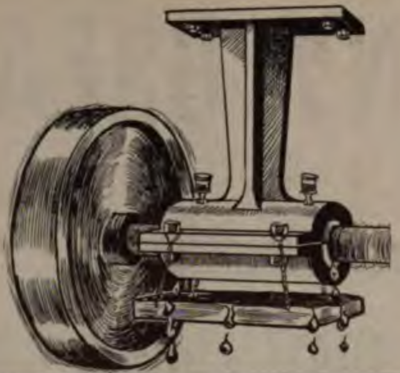

Never Waste Good Oil

Pass, once or twice used lubricating oil through an ACME OIL FILTER and it will come out as good as before it was used, prepared to do as much and as good service as it did before.

AN ACME OIL FILTER

will save its cost three times over in reducing oil bills in the course of a year. To prove this, we will send one on

30 DAYS' TRIAL

free of charge, to be returned to us, at our expense, if it does not filter more oil, much better, and in less time than any other.

Walter L. Flower Filter Co.

1011 Chemical Building

ST. LOUIS, MO.

One for me
One for the Oil Company

Thousands of lubricating oil users have, with the help of the

WHITE STAR OIL FILTER

cut their oil bills squarely in two.

This economic power plant fact is one of vital importance to every careful manager—easily demonstrated—quickly proved.

We will be pleased to send a sample Filter on 30 days' trial FREE. If it does the work you keep it, if not, send it back.

Booklet "J" tells you all about this perfect and practical device.

PITTSBURGH GAGE & SUPPLY CO.

PITTSBURGH, PA.

OIL FILTRATION EXPERTS.

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Quincy Engine Wks
Snider-Hughes Co.
Air Compressors, Gasoline
Columbus Machine Co.
Alarms, High and Low Water
Crane Co.
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.
Arch Plates, Boiler
Lamprey Co.
Automobile Fittings
Lunkenheimer Co.
Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.
Belting
Chicago Rawhide Mfg. Co.
France Packing Co.
Quaker City Rubber Co.
Blowers
Ohio Blower Co.
Snider-Hughes Co.
Boiler Compound Feeders
International Boiler Compound Co.
Boiler Feeders
Davis Regulator Co., G. M.
Boilers
Aultman & Taylor Mch. Co.
Cooper Co., C. & G.
Harrison Safety Boiler Works.
Holyoke Steam Boiler Works.
Boiler Tube Cleaners, Mechanical
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General Specialty Co.
Lagonda Mfg. Co.
Maurer, Labadie & Co.
Pierce Co., Wm. B.
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Engineers' Review Co.
Boring Machines, Electric
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Calipers
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Clamps, Steam Joint
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Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.
Cocks, Gas
Pittsburg Gage & Supply Co.
Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.
Commutator Lubricants, Graphite
Dixon Crucible Co., Jos.
Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.
Compounds, Car Axle
Lubron Mfg. Co.
Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.
Compounds, Lubricating
Keystone Lubricating Co.
Condensers
Snider-Hughes Co.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.
Cooling Towers
Wheeler Condenser & Eng. Co.
Counter shafts
Myers & Bro., F. E.
Cutters, Gasket and Washer
McCrea & Co., Jas.
Cutters, Tube
Lagonda Mfg. Co.
Cylinders, Artesian Well
Myers & Bro., F. E.
Cylinders, Irrigation
Myers & Bro., F. E.
Dividers
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Dry Kilns
Ohio Blower Co.
Dust Collectors
Ohio Blower Co.
Dynamo and Motor Brushes, Graphite
Dixon Crucible Co., Jos.
Ejectors
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Chicago Injector Co.
Hancock Inspirator Co.
Penberthy Injector Co.
Engines, Blowing
Buckeye Engine Co.
Engines, Gas and Gasoline
Buckeye Engine Co.
Columbus Machine Co.
Marinette Gas Engine Co.
Engines, Gasoline Hoisting
Columbus Machine Co.
Engines, Hoisting
Quincy Engine Wks.
Engines, Steam
American Engine Co.
Bates Machine Co.
Buckeye Engine Co.
Cooper Co., C. & G.
Ohio Blower Co.
Quincy Engine Works.
Reeves Engine Co.
Russell Engine Co.
Exhaust Heads
Burt Mfg. Co.
Flower Filter Co., Walter L.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.
Fertilizer Dryers
Anderson Co., V. D.
Filters, Oil
Burt Mfg. Co.
Flower Filter Co., Walter L.
Lippincott Steam Spec. & Sup.
Maurer, Labadie & Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Filterers, Scale
Wright Mfg. Co.
Fittings, Brass Hydrauli
Pittsburg Gage & Supply Co.
Fittings, Steam
Lunkenheimer Co.
Sterling Lubricator Co.
Floats, High Pressure
Reliance Gauge Column Co.
Flue Cleaner Rods
McCrea & Co., Jas.
Flue Cleaners
Bushnell & Co., John S.
Cleveland Flue Cleaner Mfg. Co.
Robertson & Sons, Jas. L.
Ruggles & Ruggles.
Foot Valves
L. & D. Foot Valve Co.
Furnace Feeders
Ohio Blower Co.
Furnace, Patent
Holyoke Steam Boiler Works.
Fusible Plugs
Lunkenheimer Co.
Gage Glass Reflectors
Lubron Mfg. Co.
Gage Glass Rings
Pennsylvania Rubber Co.
Gages, Oil
Lunkenheimer Co.
Gages, Steam
Chicago Injector Co.
Pittsburg Gage & Supply Co.
Gages, Recording
Pittsburg Gage & Supply Co.
Gages, Water
Lunkenheimer Co.
Penberthy Injector Co.
Powell Co., Wm.
Reliance Gauge Column Co.

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Keep Your Boilers Clean and Safe

Nothing helps an engineer in his work more than clean, safe boilers. They are easy generators of steam, require less fuel, and repairs are few. Danger of explosion is reduced to the minimum.

On the other hand, boilers incrusted with scale necessitate a large amount of extra coal shoveling and fail to generate the required amount of steam without excessive heat. This excessive heat so weakens them that they are liable to explosion at any time. Cut down your boiler troubles by using

LORD'S BOILER COMPOUND WORKS.
GEO. W. LORD COMPANY, PHILADELPHIA.

LORD'S Boiler Compounds

These compounds are not made on the "cure-all," hit-or-miss principle, but are prepared to meet the individual requirements of each customer. This is the only sure method because the scale-forming combinations in feed waters are never the same. Send us a sample of scale from your boilers, our expert chemists will analyze it, and we will send you a certificate of analysis together with matter showing you just how we can help you. This will obligate you in no way.

Send the coupon and sample of scale today and for your trouble we will send you the above illustrated

Pocket Mirror
FREE

The
Geo. W. Lord Co.
2238-50
N. 9th Street,
Philadelphia, Pa.

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, and send me, free of charge, a certificate of analysis and the mirror

Number of boilers in use ______
Capacity of each boiler ______
Frequency of cleaning boilers ______
Frequency of opening the blow-off during working hours ______
River or other source of water supply ______
Boilers are used about ______ *hours out of 24*
Boiler compound now used ______
Name ______
Street and Number ______
City ______ *State* ______
Firm's Name ______
Eng. Review *Date* ______

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Gaskets
Goodyear Tire & Rubber Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Gear Cutting
Chicago Rawhide Mfg. Co.

Gears, Rawhide
Chicago Rawhide Mfg. Co.

Generators
American Engine Co.

Governors, Pump
Albany Steam Trap Co.
Davis Regulator Co., G. M.
Fisher Governor Co.
Foster Engineering Co.

Graphite
Dixon Crucible Co., Jos.

Graphite, Flake
Dixon Crucible Co., Jos.

Grate Bars
Bushnell & Co., John S.
Holyoke Steam Boiler Works.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grates, Shaking
Lippincott Steam Spec. & Sup. Co.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grease
Cook's Sons, Adam.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
Lubron Mfg. Co.

Grinders, Valve
Quaker City Rubber Co.

Hammering Machines, Die Plate
Bates Machine Co.

Heaters and Purifiers, Feedwater
Bates Machine Co.
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
National Pipe Bending Co.
Quincy Engine Wks.
Robertson & Sons, Jas. L.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Heaters, Hot Water House
National Pipe Bending Co.
Stewart Heater Co.

Heating Apparatus
Ohio Blower Co.

Hose
Goodyear Tire & Rubber Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Indicator Instruction
Indicator Instruction Co.

Indicators, Speed
Starrett Co., L. S.

Indicators, Steam Engine
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Injectors
American Injector Co.
Chicago Injector Co.
Hancock Inspirator Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.

Inspirators
Hancock Inspirator Co.

Lace Leather
Chicago Rawhide Mfg. Co.

Levels
Starrett Co., L. S.

Lubricators
American Injector Co.
Chicago Injector Co.
Detroit Lubricator Co.
Greene, Tweed & Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.
Sterling Lubricator Co.
Williams Valve Co., D. T.

Lubricators, Automobile
Lunkenheimer Co.

Machinery, Oil Mill
Anderson Co., V. D.

Machines, Drilling
McCrea & Co., Jas.

Machines, Electric Boring
McCrea & Co., Jas.

Micrometers
Starrett Co., L. S.

Mill Equipment, Wire
Bates Machine Co.

Motors
American Engine Co.

Nail Machines, Wire
Bates Machine Co.

Nail Rumblers
Bates Machine Co.

Oil and Grease Cups
American Injector Co.
Bushnell & Co., John S.
Chicago Injector Co.
Detroit Lubricator Co.
France Packing Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Merrill, G. U.
Penberthy Injector Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Oils
International Boiler Compound Co.
Lubron Mfg. Co.
Standard Oil Co.
Vacuum Oil Co.

Paching, Metallic
France Packing Co.
Goodyear Tire & Rubber Co.

Packing, Rawhide Hydraulic
Chicago Rawhide Mfg. Co.

Packing, Sheet and Fibrous
Chicago Rawhide Mfg. Co.
Crandall Packing Co.
France Packing Co.
Goodyear Tire & Rubber Co.
Gould Packing Co.
Greene, Tweed & Co.
Lubron Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Robertson & Sons, Jas. L.

Packing Tools
Mound Tool & Scraper Co.

Paint
Dixon Crucible Co., Jos.

Pencils and Crayons
Dixon Crucible Co., Jos.

Pinions, Rawhide
Chicago Rawhide Mfg. Co.

Pipe and Fittings
Crane Co.

Pipe Cutting and Threading Machines
Armstrong Mfg. Co.
Columbus Machine Co.
Toledo Pipe Threading Machine Co.

Planimeters
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Pumping Jacks
Myers & Bro., F. E.

Pumps, Air
Canton Pump Co.
Wheeler Condenser & Eng. Co.

Pumps, Centrifugal
Wheeler Condenser & Eng. Co.

Pumps, Oil
Greene, Tweed & Co.
Lunkenheimer Co.
Penberthy Injector Co.
Sterling Lubricator Co.

Pumps, Power
Myers & Bro., F. E.
Quincy Engine Wks.
Stewart Heater Co.

Pumps, Steam
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Pumps, Vacuum
Wheeler Condenser & Eng. Co.

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Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

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Bushnell & Co., John S.
Davis Regulator Co., G. M.
Lagonda Mfg. Co.
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Regulators, Feedwater
Lagonda Mfg. Co.
Merrill, G. U.

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Davis Regulator Co., G. M.
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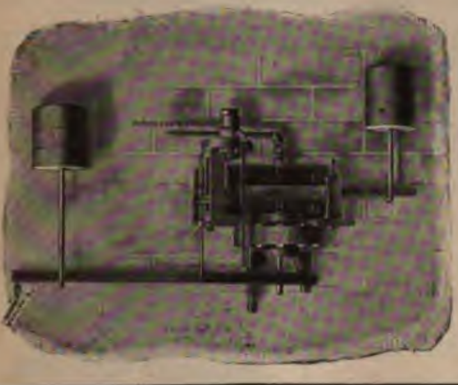
The Wise Engineer's Second Talk:

I won't say "I told you so"—it't like kicking a man when he's down—but I knew you'd find out that this

WEINLAND Tube Cleaner

is the best of the bunch. If you used it instead of that "just as good" thing the hose wouldn't have come off, and the old man wouldn't have kicked about the water bill, and you wouldn't have kept the plant shut down so long. You can't beat the Weinland for getting out any old scale with the least fuss and power. The Lagonda folks'll clean your boilers with this or **Power Cleaner** on contract, too, you know, besides selling it outright. Yes, their tube cutter is another good thing—cuts off tubes anywhere nice and clean in a jiffy.



Old man kicking about coal bills? Sure! Use a Lagonda Damper Regulator—that'll tickle him.

Why don't you get a Lagonda booklet?

The Lagonda Mfg. Co.

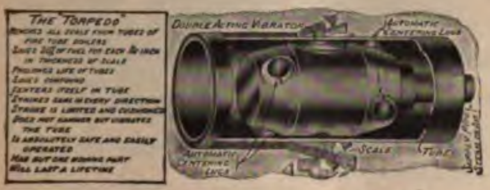
Boiler Cleaning Experts. At it 20 Years

Springfield, Ohio

New York Chicago Pittsburg Philadelphia St. Louis London

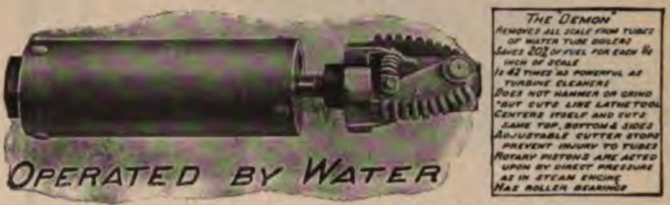
WHY NOT INVESTIGATE

THE "TORPEDO"


THE "TORPEDO"
REMOVES ALL SCALE FROM TUBES OF FIRE TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/8 INCH IN THICKNESS OF SCALE
PROLONGS LIFE OF TUBES
SAVES COMPOUND
CENTERS ITSELF IN TUBE
STRIKES SAME IN EVERY DIRECTION
STROKE IS LIMITED AND CUSHIONED
DOES NOT HAMMER BUT VIBRATES THE TUBE
IS ABSOLUTELY SAFE AND EASILY OPERATED
HAS BUT ONE MOVING PART
WILL LAST A LIFETIME
DOUBLE ACTING VIBRATOR
AUTOMATIC CENTERING LUGS
AUTOMATIC CENTERING LUGS
SCALE
TUBE

FOR FIRE TUBE BOILERS

THE "DEMON"


OPERATED BY WATER
THE "DEMON"
REMOVES ALL SCALE FROM TUBES OF WATER TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/8 INCH OF SCALE
IS 42 TIMES AS POWERFUL AS TURBINE CLEANERS
DOES NOT HAMMER OR GRIND BUT CUTS LIKE LATHE TOOL
CENTERS ITSELF AND CUTS SAME TOP, BOTTOM & SIDES
ADJUSTABLE CUTTER STOPS PREVENT INJURY TO TUBES
ROTARY PISTONS ARE ACTED UPON BY DIRECT PRESSURE AS IN STEAM ENGINE
HAS ROLLER BEARINGS

FOR WATER TUBE BOILERS

The "Torpedo" is a wonder for finding scale where you think there is none. Hundreds of delighted users will testify to this as well as an immense saving in fuel, boiler repairs, etc. The boilers of the Bissell Carpet Sweeper Co., Grand Rapids, Mich., were reported clean by their boiler inspectors. A trial of the "Torpedo" in one boiler resulted in seven bushel baskets of scale removed weighing 438 lbs. Maybe yours are the same kind of clean (?) boilers. Take the "Torpedo" on free trial and see for yourself.

The "Demon" is the biggest improvement ever made in water tube cleaning. A new form of self-contained motor which is so powerful as to allow the use of a cutter that ***cuts*** the scale in contradistinction to loosely mounted cutters that grind or wear down the scale. The cutters of the "Demon" must cut as they are held steadily and firmly against their work by stiff springs but when the scale has been cut away they revolve freely without friction on the tube. Give the "Demon" a trial. It will surprise you.

The General Specialty Co.

73 Carroll Street,
BUFFALO, N. Y.

"Lightning Tube Cleaner" Features

1—Cleans scaled tubes inside or outside.
2—Propelled by water, air or steam.
3—Does the work quick.
4—Saves $2.00 every 10 hours run metered water bill.
5—Motor Wheel utilizes a compound power.
6—Construction overcomes cone and ball breakage.
7—Has re-sharpening, non-breakable cleaner head.
8—Future repairs, very small item.
9—Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

Sold on approval. Attractive proposition to State Agents.

MAURER, LABADIE & CO.
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CENTURY
The Original White Packing.
FOR SALE BY LEADING SUPPLY HOUSES.

Cleveland Flue-Cleaner Manufacturing Co.
Forcing a spiral jet of steam entire length of tube.

Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.
The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.
Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO.

30 Days Trial

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RUGGLES
Perfection Flue Cleaner

is the simplest cleaner on the market and is one of the most efficient. No screws or rivets used in its construction. Sharpens itself.
Strong and reliable.
Send for one on trial.

Ruggles & Ruggles
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There are three important things to consider in buying packing. One is lubricating value—another elasticity—and last but not least, lasting qualities.

When you buy

Crandall Packings

you buy a full measure of all three.

Speaking of lubrication, no packing is so well saturated with high grade lubricating oil as Crandall's—and all because of our process of applying cold oil to raw material; as for its elasticity (the give and take properties) and its lasting qualities, Crandall has an enviable reputation — a reputation all its own.

Style No. 295
Expansion for Steam Hammers, Oct
gon Rods, Etc.

There is more than an even chance that Cranda Packing will outwear, two to one, any thing in th packing line you can put beside it.

Don't take this for granted,try Crandall. New catalog showing full line, sent on request.

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If you want the Best Get

Gould's *Steam and Water* **PACKING**

In ordering give *exact* diameter of Stuffing Box and Piston Rod or Valve Stem.

See that our name and trade mark is on every package.

Registered Trade Mark

Gould Packing Co.
ALBION CHIPMAN, Treas.
East Cambridge, MASS.

Ring Packing.

"Noiseless Running."

Chicago Rawhide Gears and Pinions

"Original Rawhide."

Rawhide Hydraulic Packing

It is anti-frictional and the most durable on the market.

The Chicago Rawhide Mfg. Co.
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are specially treated with

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They outwear and outlast all others and are self lubricating. If your packings give you trouble send us an order. If your packings work all right try ours once, they will work better. The only fault we find with our goods is that they wear too long.

THE LUBRON MFG. CO.
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Packing laid up from Asbestos Wick or Cotton Yarn and doped up with grease and graphite, has no springiness—no resilience—set it up tight enough to stop leakage and it's liable to harden in the gland or char under any degree of heat.

How many valve stems have been cut, scored and twisted by the use of such packing.

PALMETTO TWIST PACKING

never hardens under any pressure or temperature. Valves work easy and don't blow where **Palmetto Twist** is used.

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FREE SAMPLE SPOOL

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Do you own an Indicator?

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All of these are mentioned in the list which will be sent to every man who fills out and forwards to us the blank below. All are given free for coupons which come with every pound of soft and sheet and every inch of metallic packing.

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Manufacturers of Metallic, Fibrous and Sheet Packing.

Our packings have been on the market for years and are used in the largest plants in the world.

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This coupon represents a

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For our free premium list fill out and mail us blank below.

Tear off Here

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Date........................1905

Gentlemen:—Kindly send me premium list and full particulars regarding the indicators and other articles that you are giving to engineers.

My name is........................

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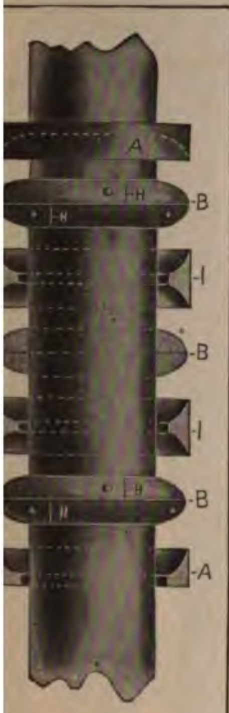
nly Perfect Packing



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AKRON
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GUARANTEED
For Piston Rods, Valve Stems, Pumps, Etc.

Our Everlasting Sheet

For Ammonia and High Pressure Stands Alone.

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We give all "A SQUARE DEAL"

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EUREKA PACKING

Because it can be readily cut into rings to fit any size rod, and set aside to be used when required without losing the elasticity or any of its wearing qualities. This is only so, however, with Genuine Eureka Packing. Now see that what you buy is Genuine.

Did you see our ad describing the way to cut Eureka Packing into rings?

Robertson-Thompson Indicator.
Sold on easy terms to suit Engineers.

A Robertson-Thompson Indicator

Many an engineer owes his position as chief to the fact that the more he studied his engine the more he realized the absolute necessity of using an indicator, and, therefore, secured one.

Robertson-Thompson Indicators are sold on terms to suit any engineer with reference.

A Victor Reducing Wheel

Victor Reducing Wheel

will give an absolutely perfect reduction of stroke to card size without any variations whatever. May be connected while the engine is in motion.

Glad to go into details with you regarding our Willis Planimeters, Hine Eliminators, Feed Water Heaters, Spencer Damper Regulators, Shaking Grates and Exhaust Heads.

JAS. L. ROBERTSON & SONS,
402 Fulton Street, NEW YORK.

Throw Away Your Packing Hooks

No more disagreeable packing jobs. Start right by packing your engine with P. P. P., and your packing troubles are over. Then, when more packing is needed, simply add a new ring of P. P. P.—that's all. The long, disagreeable, after-hours job of pulling the old hard packing out of the hot stuffing box is entirely done away with, and Sundays and evenings are yours. In addition to this, P. P. P. lasts ten times as long as ordinary packing or the imitations of P. P. P. So, while it makes your work much lighter, it saves considerable money on the packing and coal bills.

P. P. P.

works both ways—for you and for your employer. It stands the test. As a partial proof of our statements we reproduce the following letter. For a full proof fill out the coupon below.

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We use P. P. P. Packing, carrying 100 lb. steam pressure, on a Twin City Corliss Compound Engine, and ran one set of packing on the main rod two years and nine months, adding during this time of service, one ring, which I consider unusual service. I have used every known packing in the market, but never have been able to secure such service from any of them. I adjust the gland nuts with my hands only, never using a wrench, and the packing runs practically without friction.

HERMAN POFAHL, Chief Engineer,
Polar Star Electric Company.

The Quaker City Rubber Co. Philadelphia.

Gentlemen: Please send me your booklet proving that P. P. P. will save money

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INDICATORS, REDUCING WHEELS, PLANIMETERS, SEPARATORS, ETC., ETC., TO

Lippincott Steam Specialty & Supply Co.,

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OUR OFFER OF A

FREE INDICATOR

with our course of Indicator Instruction (by mail) will soon be withdrawn. If you are an engineer desirous of learning indicator work "to a finish," and wish to get a fine Indicator outfit to practice with, you should read our ad in the Engineers' Review for March, and then write for further particulars, which are free. Address

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THE SOOT SUCKER draws the soot from the tubes without admitting steam into them.

Bachelder Indicator with Ideal Wheel attached

Complete, convenient and reliable; ready for various pressures without change of spring; guaranteed correct.

Carmichael Damper Regulator. Automatic Oil Cups.
Grate Bars, all kinds.
Steam and Oil Separators. Furnace Blowers.

Send for our Catalogue.

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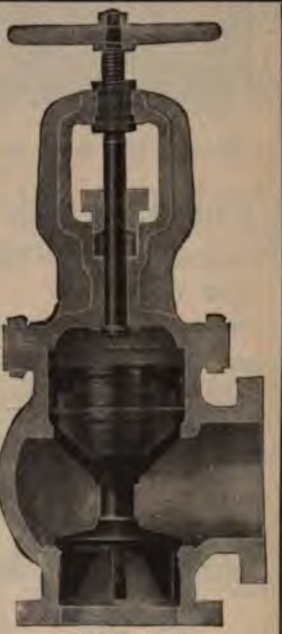
The Anderson Cushioned Non-Return Valve

Is one of the most perfect devices of the kind on the market.

Strong, reliable, well-made, durable and positive in action.

The cut shows the perfected ashpot arrangement which is necessary to avoid the chattering and hammering which so often exists in this class of valves.



ANGLE OR GLOBE

We also make the

Golden Tilting Steam Trap

Get the Catalog of our Specialties.

The Golden-Anderson Valve Specialty Co.

200 Pike Street, PITTSBURG, PA.

Get the POWELL Habit

That habit is quality and satisfactory prices—something tangible relating to steam brass goods for the engine and boiler room.

In quick opening lever valves, such as throttles for road engines, saw mills, coal hoists, autos, laundry machinery, oil pipe lines and all uses where it is desired to start and stop quickly a full flow of fluid.

The "POWELL TITAN" for pressures up to 175 lbs. or the "POWELL READY" for pressures up to 75 lbs. are unquestionably the valves to use.

No jambing, no sticking, durable, thoroughly dependable, quick acting, full open way valves.

Jobbers in your territory will quote prices and furnish circulars. A trial order is most convincing.

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"TITAN" Throttle Valve

The Hancock Valves.

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Made in one Grade only

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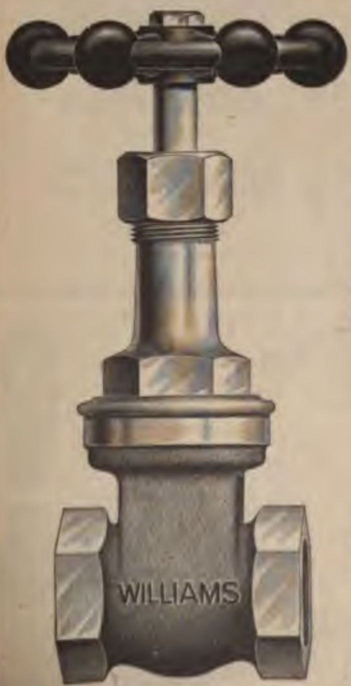

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PRESSURE REGULATOR

It's Worth While

to investigate the merits of our specialties if you want to get the best results possible from the use of such appliances. We can refer you to any number of well known concerns using DAVIS VALVES who would substantiate all our claims, but better still we will send them to you **on trial**, and if they do not **make good** we will not expect you to keep them. Did you ever buy goods on a better basis?

All prominent jobbers sell DAVIS VALVES.
Complete catalog on application.

Pressure Regulators, Steam Traps,
Damper Regulators, Relief Valves,
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Back Pressure Valves

G. M. Davis Regulator Company

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ESTABLISHED THIRTY YEARS.

STEAM TRAP

Engineers can depend upon the

Chicago Automatic Injectors

doing what we claim for them.

We have the most extensive testing plant in the United States and each injector is tested under actual conditions before leaving our factory.

Place a Chicago Injector on your boiler and your injector troubles are ended.

The Chicago is for sale by all dealers.

Send for our 1905 catalogue showing our full line of Injectors, Lubricators, Grease Cups, etc.

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U.S. Automatic Injector

COSTS LEAST FOR REPAIRS

Has the simplest construction and fewest wearing parts. Is made to last, and does it. Best for stationary and portable boilers and best for marine purposes.

The only perfectly satisfactory injector for traction engines. If feed should be interrupted it restarts automatically, the minute suction hose reaches water.

The U. S. Automatic Injector is backed by the recommendation of the U. S. government and by the endorsement of over 200,000 engineers.

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Ask for catalog of ejectors, grease cups, oil cups, jet pumps, fire plugs, water heaters, etc.

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The Big 4 For Every Engineer

Penberthy Automatic Injector

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TRADE
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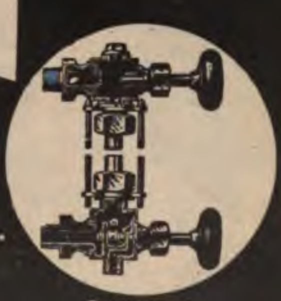
is a Guarantee of Excellence.
No Boiler Room is Complete
Without Them
Simple, Reliable, Durable, Economical.

Penberthy Force Feed Oil Pump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pairing leaks at joints where pipes are screwed
fittings. Made of Brass for all sizes of pipe.

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For repairing splits and rust-holes. Made of malleable iron from ½ inch to 4 inches.

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The Purpose of a Lubricator

is to oil the engine when in operation and to do it efficiently. The

STERLING
Force Feed
Lubricator

accomplishes this in a most thorough and satisfactory manner. Of perfect workmanship and design, it easily saves 30% of the oil compared with a sight feed lubricator.

It can be successfully used on any type of engine.

Write for our booklet which treats the subject thoroughly.

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Lunkenheimer Oil Cups

WILL PROLONG THE LIFE OF BEARINGS AND PREVENT THEM FROM GETTING HOT

Strong, Well Made, Practical and Durable

MADE IN GREAT VARIETY AND IN ALL SIZES WITH AND WITHOUT SIGHT-FEED. GUARANTEED TO GIVE PERFECT SATISFACTION.

If your local dealer cannot furnish them notify us

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Sight-Feed Glass Oil Cup

We manufacture a complete line of Brass and Iron Globe and Gate Valves, Hydrostatic and Mechanical Lubricators, Whistles and Whistle Valves, Oil and Grease Cups, Pop Safety and Relief Valves, Injectors and Ejectors, Blow-off Valves, Water Columns and Gauges, Cocks, Generator Valves, Fittings, Etc.

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IE NATIONAL FEED WATER HEATER

2,000,000 Horse Power in Daily Use.

rincipal characteristics of these heaters are SIMPLICITY, CHEAPNESS, RELIABILITY and EFFECTIVENESS and full amount of heating surface in every heater.

Supplies Water to the Boiler at 212° F.

/e manufacture the Original and Only Genuine First-Class Coil Feed Water Heaters.

Made and sold only by

THE NATIONAL PIPE BENDING CO.

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We also manufacture all kinds of
IN IRON, BRASS AND COPPER PIPE

Catalogue and Prices on application.

The National

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There are 800,000 of them in use.
More of them are sold than of all other makes combined.
They are used by fully nine-tenths of the prominent American Engine builders.

It requires merit to establish such a record.

Catalogue on application.

Detroit Lubricator Company,

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conomy and Efficiency

Both obtained from the use of the

"Ideal" Twin Suction Strainer

in connection with your condenser or feed pump.

It catches all refuse that may be in the water flowing in any pipe, such as the suction to feed, or bilge pump, or injection pipe, to condensers. **Refuse can be removed without stopping flow of water.**

It saves time, money, trouble and annoyance.

It is a duplicate Siames Twin proposition with one always on the job and the other ready for business. Write me for booklet and prices.

G. U. Merrill,

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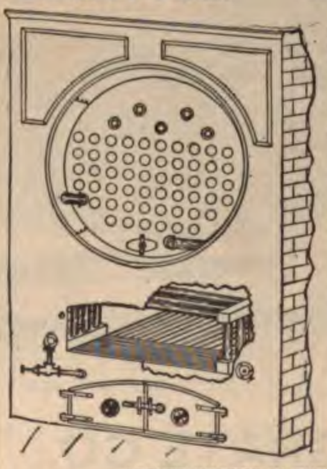

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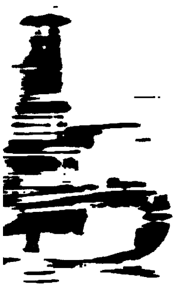

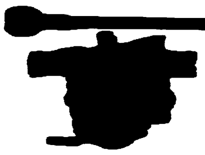

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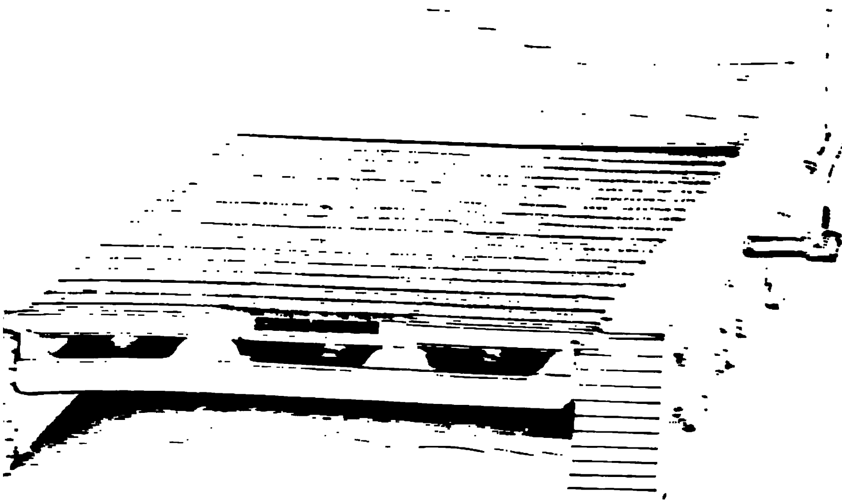

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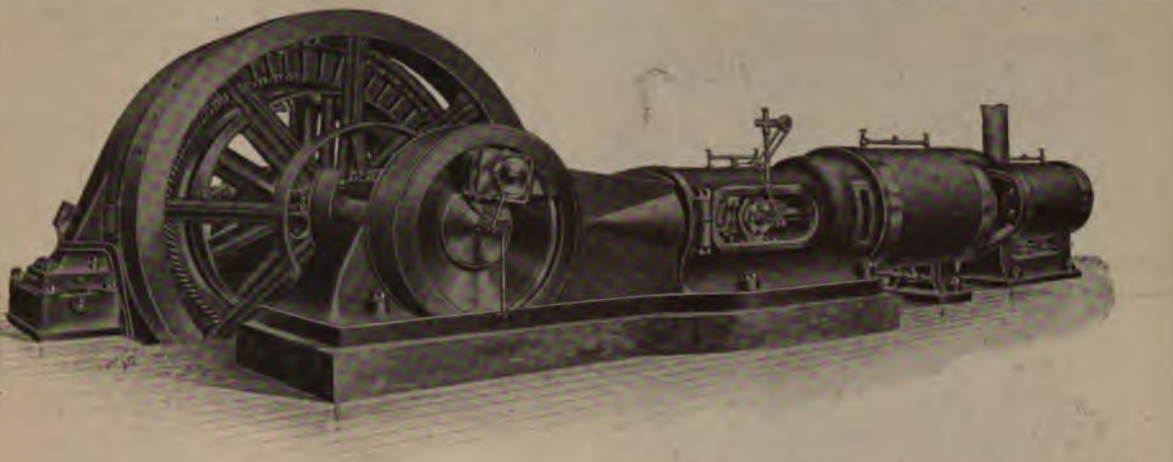

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ENGINEERS' REVIEW

Vol. 16
No. 7.

CLEVELAND, SEPTEMBER, 1905.

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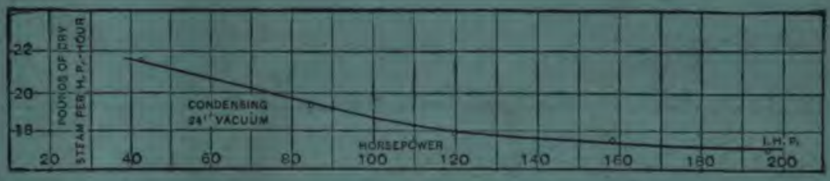

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ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

VOL. 16. CLEVELAND, SEPTEMBER, 1905. No. 7.

PAN AMERICAN PLATE GLASS CO.'S GAS ENGINE PLANT.

The claim made by many engineers that certain types of gas engines can be operated at a higher efficiency than the steam engine seems to be borne out in the fact that the thermal effiiciency of our highly perfected triple and quadruple expansion engines rarely exceeds 16 per cent under operating conditions, while in certain types of the gas engine a thermal efficiency of at least 100 per cent over the average steam engine has been obtained.

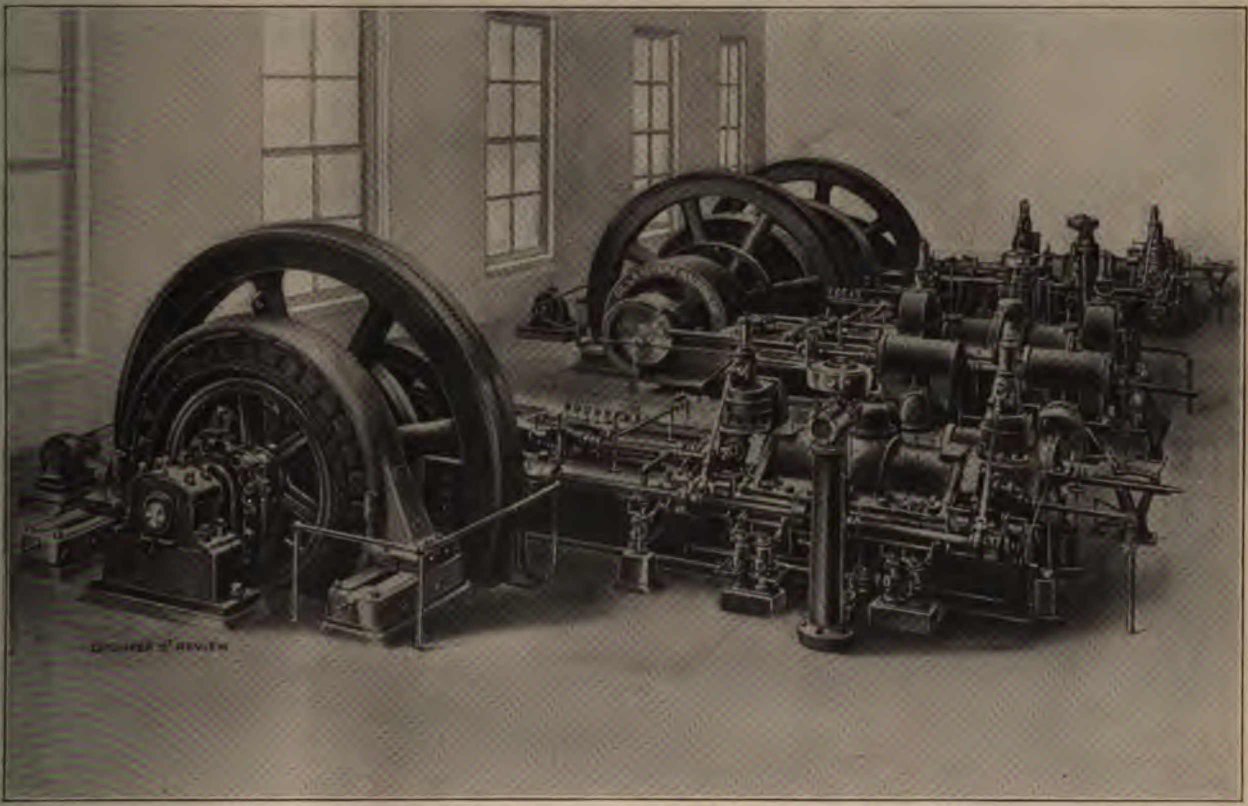


FIG. 1. KOERTING GAS ENGINES OF 600 HORSEPOWER EACH, AT THE PAN-AMERICAN PLATE GLASS CO.'S PLANT.

Evidently the Pan American Plate Glass Co., of Alexandria, Ind., were convinced that gas engines were more economical than steam, as their plant consists of three, single cylinder, two-cycle double acting Koerting engines of 600 brake horsepower, each direct connected to a Westinghouse 400-kilowatt, 25-cycle, 440-volt, alternating current, three-phase generator running at 100 revolutions per minute.

As will be seen from the accompanying illustrations, Fig. 1 of which shows the engine room, these engines are made in right and left hand units, the exciters being belted from a band wheel rim bracketed on to the spokes of the flywheel. By a system of valves handled by levers which are shown in the illustration near the head of the main cylinder of each engine, the engines can be changed over from natural gas, on which they usually operate, to producer gas, or from the latter to the former, without lessening the speed. We understand that the producer plant for this company has not yet been put in.

These engines have operated continually from Monday until Saturday night ever since they were installed, and so far there seems to be little need of a producer plant. When running on natural gas, approximately 11½ cubic feet are consumed per brake horsepower. The actual cost of power per electrical horsepower, including natural gas at 8 cents per thousand cubic feet, attendance, oil, waste, etc., under the varying conditions of load covering a period of three months was less than 3-10 of a cent.

The Koerting engine is designated similar to and is double acting, like the steam engine, while the ends of the main motor cylinders, connecting-rods, crank and other mechanism for transmitting power, from the expanding gas to the engine shaft are also similar in design to the steam engine.

In this engine the exhaust ports are located in the middle of the cylinder through which the products of combustion escape to the atmosphere. These ports are uncovered just as the engine reaches a dead center. At this point the charging pump supplies the cylinder with a fresh mixture of air and gas, which is compressed on the return stroke and ignited to do work on the succeeding outstroke.

The valve gear is so adjusted that before the combustible mixture is admitted to the cylinder, a certain amount of air is allowed to enter and sweep it of all burnt gases. During the return or in-stroke the admission valve is closed and the charge of gas and air thus trapped in the cylinder is compressed by the return piston. Just at the instant the engine passes the dead center the charge is ignited and the expansive power of the burning gas is exerted directly on the piston and transmitted to the engine shaft. The same operation takes place in the opposite end of the cylinder, compression taking place at one end while expansion is going on at the other.

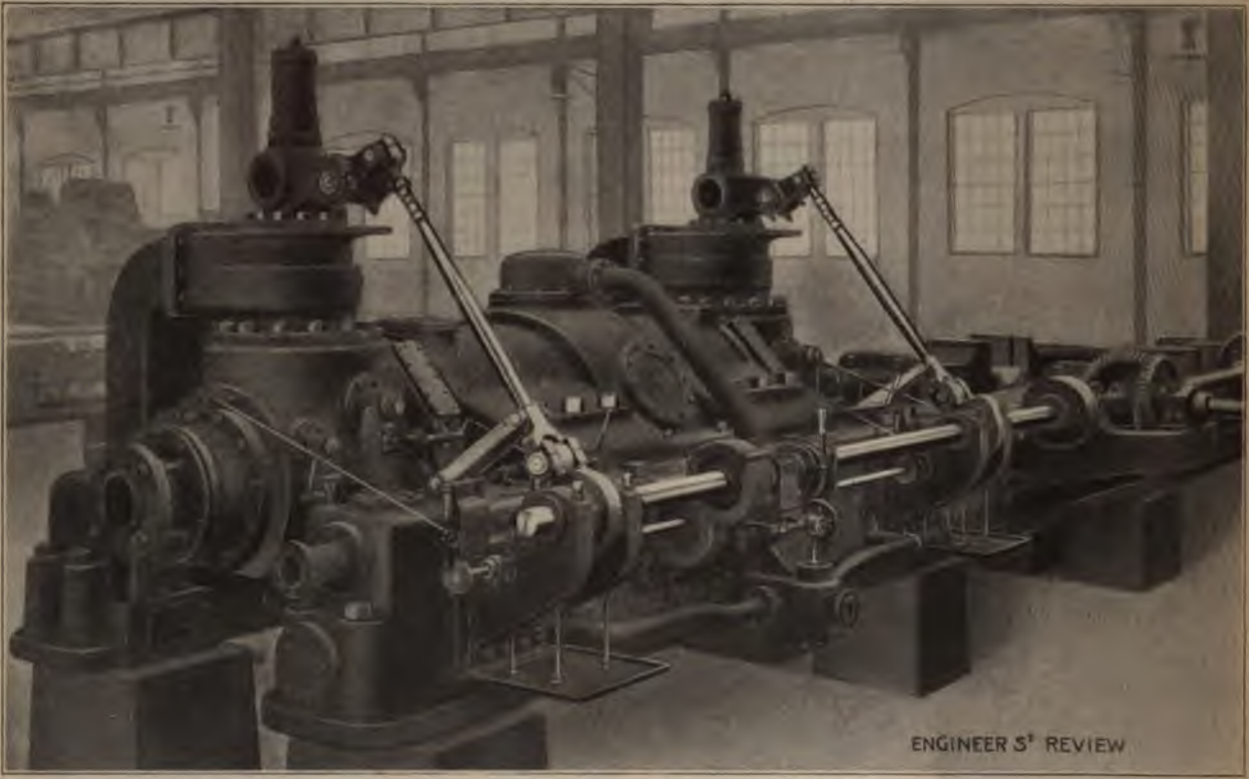


FIG. 2. VALVE GEAR OF KOERTING GAS ENGINE.

The motor cylinder of this engine has only two valves, one located at each end of the cylinder for the purpose of admitting gas and air. These valves, which are of the "poppet" type, are actuated by means of levers and push rods from cams on the main valve gear shaft, which in turn is driven by mitre gears from the main engine shaft as shown in Fig. 2.

One of the principal sources of annoyance in gas engines has been caused by exhaust valves. In these engines there are no exhaust valves as the main piston, cooled by a water circulation, performs the function of the exhaust valve by covering and uncovering at the proper time the ring of exhaust ports already mentioned, which are cored out in the middle of the wall of the main cylinder and extend about two-thirds the way around its entire circumference.

The charging pumps supply fresh charges of gas and air to the cylinder and are driven by a crank and connecting-rod from the main shaft of the engine. The pump discharge valves are positively driven from eccentric on the main shaft. The pressure under which a new charge is supplied by the pumps is just sufficient to drive the exhaust gas through the exhaust ports during the time they are uncovered by the piston. The charging pumps are made to perform not only the functions of compressing and delivering the air and gas into the cylinder, but also of measuring out the exact ratios is necessary to perfect combustion and consequently maximum efficiency.

With these engines two magnetos and two igniting plugs are provided at each end of each cylinder. The armatures of these magnetos do not run continuously, but by means of a cam and lever operated from the ignition gear shaft, as shown in Fig. 2, are made first to turn slowly through an angle of about 30 degrees, at which point the cam disengages the lever and a spring gives the armature a quick turn back to its original position, sending a high potential sparking current through the plugs. Just as this current reaches its maximum strength the contact points in which the magneto wires terminate within the cylinder head, are separated and a very hot ignition spark results. Thus it will be seen that there are no batteries or spark coils to run down or get out of adjustment, the electric spark being produced by magnetos. By this means a strong igniting spark is always available no matter he speed of the engine may be. The spark pro- by the first revolution of the engine in starting just as strong as when the engine is running at ›eed. This is a feature of inestimable value in g the engine.

shown in Fig. 2, the moving parts of the ignition ıre operated by a small shaft running parallel d driven by a spur gear to the main valve haft. The ignition gear proper is connected with ıaft by a movable sleeve which slides spirally feather. This sleeve may be adjusted to throw gniting mechanism, either in advance or be- he main gear shaft. The ignition can be easily by this means, even when the engine is running l speed. The engines are generally started by essed air stored in a receiver in which the pres- s maintained by an auxiliary air compressor, a re of from 90 to 120 pounds being required.

ile the engines illustrated in Fig. 1 are only of ›rsepower, the Koerting two cycle engine is built s ranging from 400 to 3,000 horsepower. It is ed that the De La Vergne Co., manufacturers of engines, have sold in the United States and have operation in the last four years over 42,000 ›ower, while the aggregate is over 100,000 horse- .

ELECTRICITY FOR ENGINEERS.

MOTOR CONTROLLERS.

BY JOS. VAN ALLEN.

rapid growth in the application of motors to lual machines such as planers, printing presses, pumps, and numerous other machines, has ht out many types of motor controllers; but ver the design, the principle and object are the The object of the controller is to enable the or to run his machine at any desired speed below l. A controller is a starting or resistance box in series with the motor. When the motor is to rted the controller is started by turning the lever switches the motor into the circuit, but with a esistance. By turning the lever a little farther, the next contact, the resistance is cut out a little ime and the speed of the motor gradually in- d.

wiring and outline drawing in Fig. 1 shows the controller is wired so as to vary the speed of otor by cutting resistance into the armature cir- nd also into the field circuit. The speed is re- by cutting resistance into the armature circuit, increased by cutting it into the fields. It will n that the connections are the same as those of otor starter. The switch *A* connects to the line *B* and *C*. From the switch *A* the wire *D* runs lower brush, and the wire *E* is connected to the the switch lever *F*. The resistance *H* and seg- are in the circuit of the armature of the motor, een by tracing the wires. The resistance *J* and nt *K* are connected in the motor field circuit.

vill be seen that there is a magnet *L* which acts same way as in the motor starter and opens the ıt through the armature when the current gives om any cause on the line. The segment *M* which ıched to the end of the lever *F* has teeth as , while the armature *N* of the magnet *L* carries ng catch on the end which engages the teeth on the segment *M* and *N* is drawn down by the attraction of the magnet *L*.

The resistance *H* is of sufficient size to safely carry the armature current for any length of time without getting too hot. If the motor is to run very slow for a time the lever *F* is moved over the contacts connected with the resistance *H* until the desired speed is obtained, and it may be left in that position. Here is where the segment and teeth come in, for the catch on the end of *N* engages with the teeth on the segment *M* in this position and prevents the lever *F* from being thrown back to the stop *P* by the spring which is attached to the arm at the stud, as in the case of motor starters.

If it is desired to run the motor at its normal speed, the lever *F* is moved around until it comes in contact with the segment *I* which cuts out all the resistance in the armature circuit. If a greater speed is required, the lever is moved still further ahead until it passes the segment *K* and makes a connection with one of the contact points in the resistance *J*. This cuts resistance into the field circuit of the motor which reduces its strength, and the velocity of the armature is increased; thus it is seen that when the lever *F* is to the extreme right, or on contact *R*, the motor will run at its greatest velocity, and the opposite result will be obtained when the lever is moved to the extreme left position, or to the first contact *S*, *i.e.* the motor will run at its slowest speed.

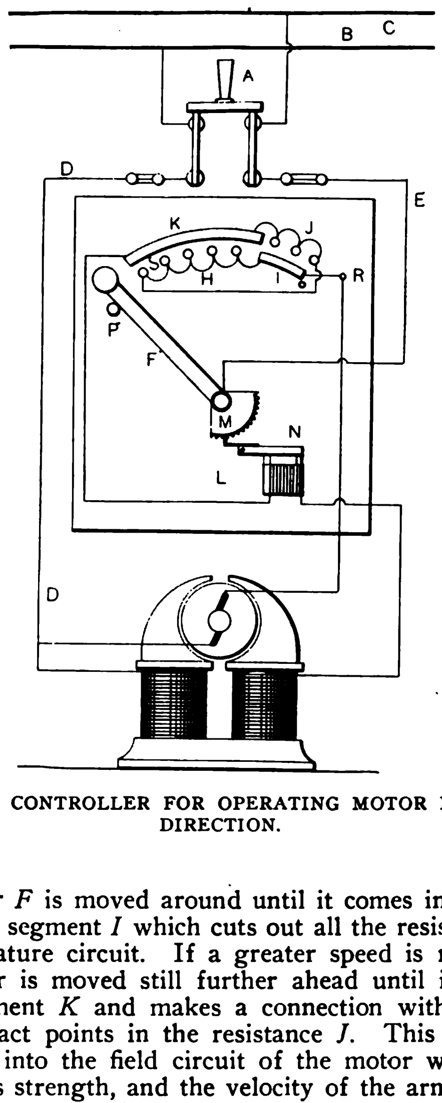


FIG. 1. CONTROLLER FOR OPERATING MOTOR IN ONE DIRECTION.

The lever *F* is held in these two positions, or in any other position, by the catch on *N* just as long as current is flowing through the motor. When the current is interrupted for any reason, the magnet *L* looses its strength and the armature can no longer hold the catch against *M*, and the lever *F* swings back to the stop *P* and so the danger of injuring the motor is done away with in case the current comes on again suddenly. This controller is designed to run the motor in one direction only, and the motor can not be reversed or made to run in an opposite direction unless it is equipped with a reversing controller.

Fig. 2 shows the outlines and connections of a reversing motor controller which is arranged to run the motor at full speed in either direction, but may be used to obtain different speeds if suitable resistance is provided.

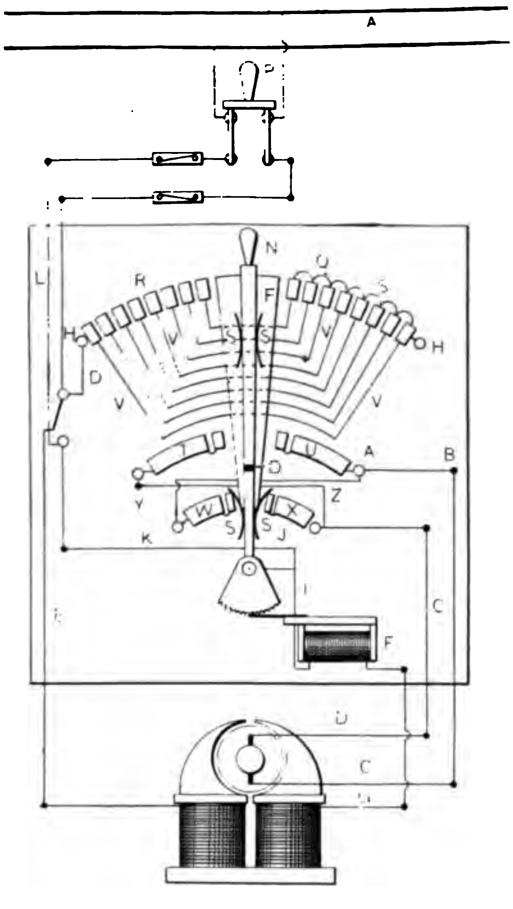


FIG. 2. CONTROLLER FOR OPERATING MOTOR IN BOTH DIRECTIONS.

The current from the line *A* passes to the switch and on to the binding post and to the contact *H* through the wire *D* while the current reaches the motor fields through the wire *E*, and on to the magnet *F* through the wire *G*. It returns to the line wire by means of the wires *I*, *J*, *K* and *L*. The magnet *F* acts precisely as the magnet in Fig. 1. The lever *N* is divided into two parts by an insulation section, as shown at *O*. If the main switch *P* is closed and the lever *N* is in the position shown, the circuit through the motor fields will be closed. This is shown by following the wire *E*. The armature circuit however will not be closed as there is no connection between the contacts *R*, *S* and *T*, *U*. The contacts *R*, *S* are connected together by the wires *V*, *V* and the contacts *T*, *U* are connected to the contacts *W*, *X* by means of the wires shown.

When the lever *N* is moved to the right, the part above the insulated section *O*, will connect *T* with the contact *S* and the current from the contacts *R* will pass to the contacts *S* by means of the wires *V*, *V* through the resistance loops *Q* until it reaches the lever *N*. The current passes through this lever to the contact *U* and through the small contact, to the binding post *B* and on to the lower brush holder through the wire *C*. The current returns from the upper brush holder through the wire *D* to the contact *X* and by means of the lower part of the lever *N* reaches the stud supporting the lever to which the wires *I* and *J* are connected. From this point the current is carried back to the line through the wires *J*, *K* and *L*.

By tracing the wiring it will be seen that the current reaches the armature through the lower brush. If the lever is moved to the left the current will go through the contacts *R* and *S* by means of the wires *V* and the resistance wires *Q* and on to the lever and from whatever contact it may be resting upon, the current will pass to the contact piece *T* and then on to the upper brush, and return from the lower brush through the wire *C* to the contact *W* by means of the wire *Z*, and through the lower section of the lever to the wire connecting to the wire *I* and back to the line wire through the wires *J*, *K* and *L*. The piece *F* is for the lever to move over, and is not connected to the circuit in any way. The springs *S S S S* are for the con-purpose of making a better contact when the lever *N* is at its extreme side position, the springs bearing on the contacts on either side. The toothed segment works on the same principle as that in Fig. 2. The catch on the lever extending from the magnet engages with the teeth in the segment and holds the lever in position. The lever is provided with two springs instead of one as in the case of the controller first described.

Air Compression for Mine Service.

The Homestake Mining Company has adopted pneumatic haulage for its gold mines at Lead, S. D., and has just placed an order with the Ingersoll-Sergent Drill Company for a mammoth duplex four-stage Corliss air compressor to supply the power. The question of haulage has only been decided after thorough and complete tests extending over a period of more than a year. One air locomotive was in service during that time, getting its power from a three-stage air compressor, manufactured by the above firm. The success of the locomotive and compressor having been demonstrated, 14 pneumatic locomotives are now to be installed to supersede the present mule service. The compressor to supply air at 1,000 pounds pressure for this service, will be the largest high pressure compressor in the world. There are already seven other of this firm's air compressors in active service at this mine supplying 19,413 cubic feet of free air per minute. Five of these are of the Corliss type, the largest having a stroke of 6 feet.

To test shellac, dissolve it in absolute alcohol, which will "cut" the shellac and leave impurities. Absolute alcohol should indicate 1,000 upon an alcoholmeter. Pure alcohol will burn wholly away, that which has water in it will leave most of the water behind.

CHANDLER & TAYLOR STANDARD SERVICE DIRECT CONNECTED ENGINE.

At the New York meeting of the American Society of Mechanical Engineers, December, 1901, the report of the committee on standardization of engines was presented to the society. The committee's investigation covered standardization of the following points: The standard size of units recommended; the corresponding revolutions per minute for these units; the size of shafts for the two classes of center crank and side crank engines; the length along the shaft required for the generator; the height of axis or shaft over top of sub-base; the width of top of sub-base; armature fit; overload capacity of engines and generators; brush holders, and holding down bolts, keys and outboard bearings.

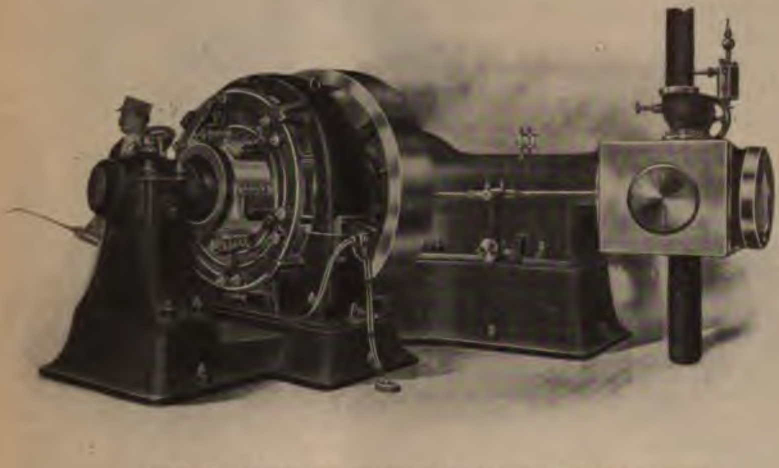


FIG. 1. VIEW OF ENGINE FROM GENERATOR SIDE.

The Chandler & Taylor engine, illustrated in Figs. 1 and 2, is built strictly in accordance with the recommendations of the joint committee of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers as to speed, size of unit and of shaft, and is the first engine in the country which has been built in accordance with their recommendations, which fact alone should commend it for careful consideration. There are many little points of mechanical ingenuity incorporated in its design, which not only makes the engine particularly interesting to engineers, but makes it one particularly adapted for this particular service.

The engine is perfectly enclosed and is arranged so that it can be operated self-oiling or with the individual oil cups just as desired. Although the engine is enclosed yet it is very accessible for inspection and adjustment. Particular attention throughout the whole design has been given to accessibility and ease of adjustment. This is a strong point for any engine.

The main shaft bearings are of particular interest. From the illustration, Fig. 3, it will be seen that the main crank bearing is self-centering and can be adjusted while the engine is in operation. It is self-oiling, and its lining shells can be replaced by duplicates without removing the shaft or moving the field frame, but by simply removing the bearing cap.

To accomplish this the main journal is surrounded by babbitt sleeves which are made cone shaped on the outside, as shown. These sleeves are surrounded entirely by two cast iron cone shaped rings. These rings can be drawn toward each other by two screw rings which engage the square thread cut on the outside. These screw rings are made with lugs cast in the outside surface so they can be turned by a pinch bar through an opening in the bearing cap.

The bearing is simple and absolutely prevents all of the pounding and jar due to hard work put on a bearing of this kind. This is partially due to absence of the usual liners or shims and to the accuracy of the adjustment.

The bearings for an engine direct connected to a generator must be kept from shifting sidewise as the shaft journal wears, because the armature which is carried by the engine shaft must at all times be kept in the center of the magnetic field of the generator. If the armature is allowed in any other position an unbalanced electrical condition will result. This will not only cause sparking at the commutator, but will also cause a side pull on the shaft at the nearest pole. The bearings of this engine have been designed to avoid these dangers.

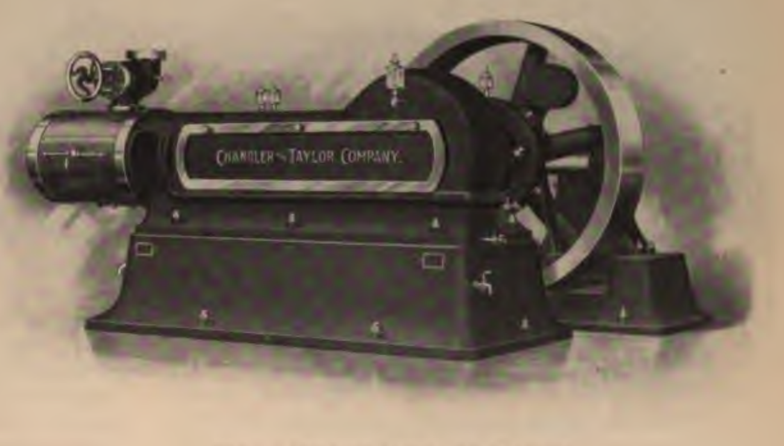


FIG. 2. FRONT VIEW OF ENGINE.

The crosshead and its oiling device is interesting because of some slight departures from ordinary practice. The body is of cast steel but the shoes, instead of being cast iron and babbitted, are made solid and of an aluminum bronze. The shoes are made with a wedge adjustment and a wedge lock is also provided in the inside of the crosshead body to keep the shoe locked firmly to the body after the adjustment is made. The pin is lubricated from a positive boat oiler which is in operation whether the engine is being run self-oiling or not. This boat is bolted to the back side of the pin and is long enough so that no matter what part of the stroke the crosshead is on, the boat always catches oil from a sight feed above. When the engine is being operated self-oiling, this boat of course is full of oil constantly.

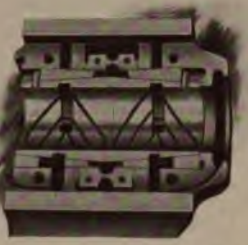


FIG. 3. CONSTRUCTION OF BEARINGS.

A view of the cylinder, piston and valve is shown in Fig. 4. It will be seen that the piston head is long and cast hollow, which gives it strength, lightness and durability. The piston rod is fitted to a tapered hole in the piston and is held firmly in place by a suitable locknut. The steam joint between the piston and cylinder is made by cast iron snap rings so formed as to give an equal radial pressure. The valve is of the well known double ported type and is perfectly balanced by a heavy pressure plate which is held in position by springs pressing against the steam chest cover of the engine. Both the pressure plate and the valve are arranged so that they will clear themselves should water accidentally come into the cylinder. For this reason automatic relief cocks are not used. The double ported feature makes it possible to give large port area with short valve travel.

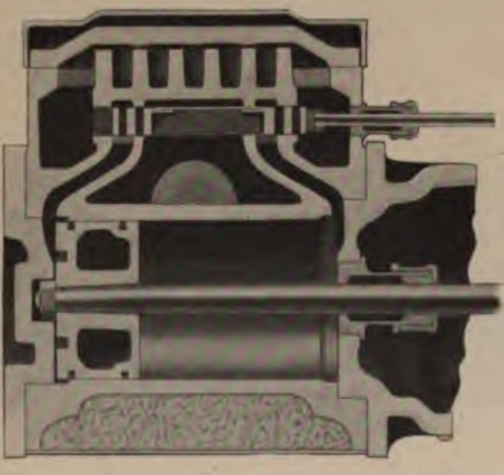


FIG. 4. SHOWING PISTON AND VALVE.

There are also some interesting changes in the governor. It is built under the Rites' Carpenter patents, the principles of which are well known, but the system of weighting has been changed somewhat to make it more efficient. The adjusting weights are all made in pairs and are inserted in pockets in each side of the inertia arm and in such a way that the center of gravity of the arm both before and after weighting lies perpendicular to the center of the governor pin. (This is shown in Fig. 5.) A self- releasing clutch bumper has also been devised which prevents the pounding of the governor arm when the engine is being shut down, and yet it allows perfectly free movement for the control of the engine when in operation.

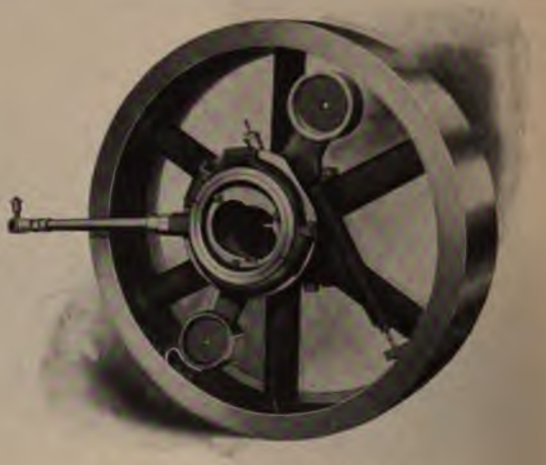


FIG. 5. RITES' GOVERNOR.

As the engine is built particularly for direct connected service its lines are in harmony with the requirements of the service and so closely has the enclosing of the parts been watched that it is very economical in the use of oil. One unit of 100-kilowatt capacity which operates continuously for seven days and seven nights regularly, uses a trifle less than 75 cents worth of both engine oil and cylinder oil during that time. If this is reduced to a years' run of 300 ten-hour days, the total yearly oil bill would be only $13.20.

The Chandler & Taylor Co., Indianapolis, Ind., manufacture this and other types of engines.

The First American Locomotives in England.

About the year 1840 the first four American locomotives for an English railway arrived in England from Philadelphia. They were built by Norris & Co. for the Birmingham & Glouchester railway, now a part of the extensive Midland system. These engines were alike in dimensions, and had cylinders 10½ inches in diameter, with a stroke of 18 inches. The driving wheels were 4 feet in diameter, and the total weight of the engine, in working order, was about 9½ tons. They bore the respective names "England," "Philadelphia," "Columbia," and "Atlantic." Their usual work consisted of a load of 33 tons drawn up Lickey incline at a speed of 12 or 15 miles per hour, and the maximum work was drawing up a load of 53¼ tons at a speed of 8½ miles per hour. Shortly after these locomotives had proved their good capabilities eight more were ordered from the same builders. It is interesting to note that all of the engines worked satisfactorily excepting one, which unfortunately blew up soon after being put in service. Two men were killed by the explosion.

PLANT WRECKED BY BURSTING FLYWHEEL.

The large flywheel of the big roll engine, in the plant of the Maryland Rail Mill, South Cumberland, Md., burst July 22, one large section of the great wheel being hurled through the roof, snapping the main girder and supports, causing the roof and part of the sides of the lower half of the building to collapse, which resulted in the death of one man and the injury of several of the employes of the company, while a number of other workmen were slightly cut and bruised.

The destruction caused by the burst flywheel was widespread. The lower half of the mill, the mill being 300 feet long and 100 wide, was completely demolished and the valuable machinery, consisting of the engine, rolls, cranes, furnaces, pumps, boiler setting, etc., were either badly damaged or totally destroyed. The huge steel frame which supported the roof and sides was badly twisted. The roof and sides fell in, converting the interior of the mill into a shapeless mass of steel sheeting, iron girders and braces, heavy timbers and machinery.

Although the accident transpired in but a moment's time, there were three distinct crashes, the first being the bursting of the flywheel, the second caused by the falling of the roof and the third by the downfall of the massive smokestack attached to the furnace.

The large piece of the flywheel which tore through the girders, was carried for several hundred feet and finally fell on a large pile of old rails in the rear of the establishment. It was over 4 feet long and weighed more than a ton.

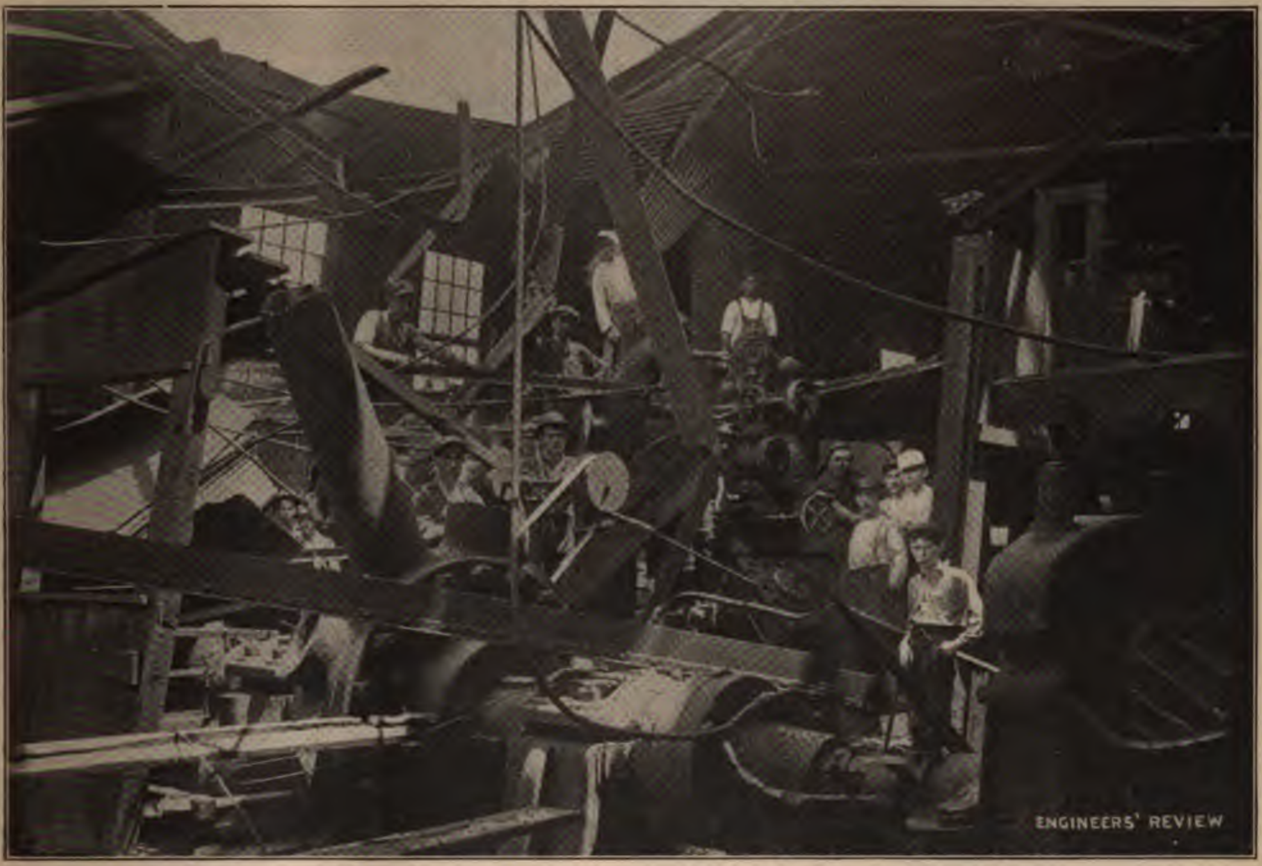
To add to the horror of the situation immediately after the accident, fire started in the wreckage, but as there was but little wood about the building the blaze was quickly extinguished. All of the firemen in the city were called out.

There is no apparent cause for the bursting of the big flywheel. It had been examined only a few days previous to the accident and pronounced flawless. At the time of the accident it was making 105 revolutions a minute.

Mr. John Milholland, master mechanic of the George's Creek & Cumberland Railway Co., made a careful examination of all parts of the broken wheel after the accident, and stated that there were no old breaks whatever. Howard H. Dickey, president of the rail company, later in the afternoon stated that the wheel had recently been examined and was pronounced flawless. The safe speed of the wheel was 150 revolutions a minute, and it has often been run as high as 130 revolutions.

Owen Walsh, the engineer, was bruised on the head by falling timber, but otherwise escaped serious injury.

The loss on the building and machinery is quite heavy, probably exceeding $10,000. About 200 persons were employed by the company, all of whom will be thrown out of employment for some time.



PHOTOGRAPH OF THE WRECKED FLYWHEEL.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION MEET.

The seventeenth annual convention of the American Boiler Manufacturers' Association was held at the King Edward Hotel, Toronto, Ont., Canada, July 25, 26 and 27. Owing to lack of space this report was crowded out of the August issue. The following is a summary of the proceedings:

The convention was called to order by J. D. Farasey, secretary, President Robert Munroe announcing the speakers. Acting Mayor John Shaw welcomed the convention to the city, to which W. H. S. Bateman responded.

After disposing of the routine business of the convention the chairman of the committee on topical subjects, J. D. Smith of Charlestown, S. C., reported among others the following subjects for discussion: Proper Size of Blowoff, Feed and Water Column Connections for Various Sizes of Boilers; What is the Proper Ratio of the Grate Area to Heating Surface, Taking into Consideration the Character of Fuel, the Intensity of Draft, etc.? Superheaters as Applicable to Return Tubular and Water Tube Boilers; What are the Causes of Boiler Explosions? and Laws Governing Boiler Inspection.

After considerable discussion it was decided that the proper size of the blowoff and water column connections for various size boilers would vary with the pressure carried on the boiler, and the condition of the water used for feed, whether free from mud and scale or otherwise, and that the maximum size should not be over 2½ inches in diameter with safety.

Colonel Meier stated in answer to the question as to the proper ratio of grate area to the heating surface, etc., that he had found that 7-horsepower can be obtained from a square foot of grate surface with bituminous coal of good quality; 5½ horsepower with anthracite; 4½ horsepower with pea anthracite, and from 3 to 3½ horsepower with buckwheat coal according to the quality. From one and one-half to twice the grate area should be allowed when using anthracite coal as compared with bituminous coal. In the case of gas as a fuel it was evident that the members considered the proper air mixture with the gas of more importance than the matter of grate area.

Col. Meier stated in the short discussion relating to superheaters that where a high degree of steady superheating is required, that it is a much better practice to have a separately fired superheater. This is because under average conditions and requirements from 10 to 15 per cent additional heat is required to run a superheater. This amounts to practically the output of heat from another grate where the plant consists of six boilers, and the grates might as well be under the superheater where it can be under absolute control as under a boiler. This question was passed over with slight discussion as the subject was considered to be of too general a nature.

The subject of boiler explosions was treated more of a joke than otherwise and was not seriously considered. The opinion among those who took part was that boiler explosions and boiler accidents were mainly due to lax inspection and carelessness in operation.

Col. Meier, chairman of the committee on uniform boiler specifications, reported that the committee is endeavoring to get a commission appointed by President Roosevelt to hear all sides of inspection law controversies, and to help straighten out all difficulties that the inspection law brings up.

A resolution was submitted and adopted, requesting the supply houses and manufacturers in general to discontinue the practice of supplying material and partly finished products to others than boiler manufacturers.

The following officers were elected for the ensuing year: President, R. Munroe, Jr., Pittsburg, Pa.; secretary, J. D. Farasey, Cleveland, O.; treasurer, J. F. Wangler, St. Louis, Mo.; first vice president; M. F. Cole, Newman, Ga., second vice president; J. J. Main, Toronto, Can.; third vice president, J. Rourke, Savannah, Ga.; fourth vice president, J. D. Smith, Charleston, S. C.; fifth vice president, G. H. Kittoe, Aurora, Ill.

The next convention will be held at Pittsburg, Pa.

CONVENTION OF MASONIC ENGINEERS.

The Grand Universal Craftsmen Council of Engineers of the World held their third annual convention at Detroit, Mich., Aug. 14, 15, 16 and 17, 1905.

The convention was called to order Monday, Aug. 14, at 10 a. m., by Chas. E. Davey, chairman of the convention. This was followed by invocation by Rev. C. L. Arnold, of Detroit. The speech of welcome on behalf of Mayor Geo. P. Codd was delivered by Hon. Chas. Flowers. Next came the speech of Congressman Edwin Denby. The responses to the welcoming addresses were delivered by Grand Chief John H. Leathers and Grand Secretary Robt. G. Ingleson. The convention was opened in the afternoon at 1:30 p. m. by Grand Chief Leathers. This was followed by the seating of delegates and the appointing of committees. The adjournment took place at 3 p. m.

The delegates were entertained that evening at a theater party at the Temple theater.

Tuesday morning a business session was held, while the afternoon was given over to a trolley ride and a visit to the Goebel Brewing Co., Belle Isle and Electric Parks.

Wednesday morning business was resumed and the afternoon was pleasantly spent in visiting the plants of the Solvay Process Co., and the Zug Island steel plant.

In the evening a moonlight excursion was given.

The business session opened on Thursday at 9 a. m. and in the afternoon the officers for the following year were elected.

The new officers are: Worthy grand chief, Jos. H. Nichols, Buffalo, N. Y.; assistant grand chief, Robert G. Ingleson, Cleveland, O.; grand secretary, John L. O'Brien, Chicago; grand treasurer, Chas. K. Olsen, New York; grand warden, N. G. Carney, Toledo, O.; grand guard, A. K. Young, Pittsburg, Pa.; grand chaplin, S. Y. High, Kansas City; grand trustees, W. J. Wranton, Rochester, N. Y.; D. Dettelback, Cleveland, O.; Chas. J. Frealig, Detroit, Mich.

The state deputies will probably remain the same the coming year as during the year past, no changes having been made.

Robert G. Ingleson, on behalf of the order, presented Past Grand Chief John H. Leathers with a beautiful silver service.

Upon request, Chief Leathers delivered a brief history of the birth and growth of this organization. Two years ago it was organized and contained a membership of 10. Now, at the end of two years, the numengineers enrolled is 1,010. This order can e as large as some of the other engineering as- ns because of the requirements to become elig- very member must be a master mason in good g.

Grand Chief Pomeroy spoke on the prospects nefits of the order. He stated that they have orking throughout the country and that the fu- the organization is very bright. They make efforts to place their members in paying posi- nd try to raise the salaries of those who are paid.

ESENTATIVE MEN FROM THE ENGINE ROOM, 25th—D. L. Fagnan.

D. L. Fagnan was born in the town of Fulton, March 9, 1873. His parents later on moved to , N. Y., where he attended the public schools

D. L. FAGNAN.

was 11 years of age. He then went to work mill as fireman, using slabs for fuel, and re- here until 1889. He then went to Chicago and began his career as a lake fireman, oiler and ly engineer.

g the winter of 1894 he shipped as fireman, nder and oiler, with the Merchants & Miners rtation Co., running out of Boston, Mass., and was transferred to the southern course running Philadelphia and Savannah, Ga. Wishing to e of the world he next shipped on a tramp running to Cuba and the West Indies, eventu- ing his discharge papers at Galveston, Texas. secured a position as fireman with the M. K. ., but a few months of railroading was suffi- fter working as fireman and oiler in several he finally returned to Chicago, where he obtained a position as engineer in a steel mill operating Corliss and Porter-Allen blowing engines. He soon after came to Cleveland, where he now resides, and secured a position with M. A. Bradley in one of his plants. He next took up refrigerating and operated a 20-ton ice plant for three seasons, eventually working into the erecting of ice plants, which occupation he followed for several years.

Tiring of the road, Mr. Fagnan returned to Cleveland and secured a position with the Emma furnace of the Union Rolling Mills as master mechanic, remaining there until February, 1900, when he was appointed engineer of Swift & Co.'s east side market, which position he now holds.

Mr. Fagnan is also trouble man for the other branches of the company in Cleveland and in nearby states. He is also supervising engineer of the Forest City Provision Co., Cleveland, O., and acts in an advisory capacity for two other firms in engineering matters. He was recently offered the position as resident inspector of boilers for the Fidelity and Casualty Co., of New York. Swift & Co. concluded that it was for their interest to retain Mr. Fagnan and did so by means of a substantial increase in salary. Mr. Fagnan is an active member of the N. A. S. E. and was for 18 months presiding officer of No. 5, of Cleveland, O.

How Oil Explodes Boilers.

That many of the so-called mysterious collapses of furnaces in apparently clean boilers is due to the presence of oil is the contention of an English engineer. He maintains that if the surface of the furnace in a boiler for 200 pounds pressure is kept clean the temperature of the metal will never reach the point at which the original tensile strength will be appreciably reduced, even under high rates of evaporation. If, however, the surface is simply rubbed over with an extremely thin coating of mineral oil, the temperature immediately rises to over 650 degrees with a moderate evaporation. It, therefore, follows that if a mere coating of oil of inappreciable thickness raises the temperature of the metal beyond the limit of safety, an extremely thin scale or deposit containing a high percentage of oil will inevitably result in dangerous overheating. He accounts for the fact that practically no oil is ever present in the harmless looking deposit found on the crown of collapsed furnaces by the theory that the temperature of the plate has been so high as to drive off the oil by distillation, and maintains that if the deposit were scraped from other parts of the boiler it would never fail on analysis to afford a solution of such accidents as are termed mysterious by those who do not realize the dangerous effect of a slight coating of oil.—*Chicago Tribune.*

In boring cylinders it is better to use three cutters than one or two. With one cutter there is spring to the bar. With two the bar is less well supported than with three. One cutter will cause the hole to be smaller in the middle than at the ends of the cylinder, and the surface of the metal will be rougher in the middle than at the ends of the cylinder.

THE IDEA·EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

Grafting Among Engineers.

Editor of the Engineers' Review:

When we see "Graft in the ——— Department" staring at us in large letters from the front page of our daily newspaper it occasions us considerable disgust and we feel that things have really come to such a pass that we do not know whom to trust.

Graft is merely another word for bribery, although it means more. One is apt to think of "graft" as being particularly associated with corrupt city officials who use their positions for the purpose of filling their pockets at the public expense. For instance: *M*, who is in charge of some public work, may have the purchase or be able to influence the purchase of a large quantity of material.

A and *B* are manufacturers of this material and are competing for the contract. There is no difference in the quality of the material furnished by these men. *A*, however, charges 50 per cent more for his goods than *B*, and in order to obtain the contract offers *M* some expensive present or even a cash bonus if the contract is given to him. If *M* accepts the gift he is a grafter and will be condemned by all honest persons as dishonest. That is the meaning of graft to most of us.

But let us look a little deeper. A manufacturer the other day said: "Engineers do not have the purchase and in most cases cannot even influence the purchase of a dollar's worth of supplies. I am in the business and know whereof I am speaking." He then cited several instances where his goods would not be given a trial simply because he had been seen talking with the engineer. What was the reason? Simply this: Owners of power plants are becoming suspicious of and losing confidence in their engineers because the engineers are accepting presents of different sorts from manufacturers whose goods they are using. In other words, employers are beginning to believe that their engineers are grafters and as such will not permit them to purchase supplies.

Another manufacturer who spent hundreds of dollars in trade paper advertising said: "I have quit advertising because any one of my salesmen can get more business with $10 worth of cheap trinkets distributed among engineers than I can with $50 worth of advertising. The engineer won't buy or recommend my goods unless I subsidize him in some way."

And is this true? It may not be in your case, but you undoubtedly know of dozens of cases where it is true. Whose fault is it? It is your fault if you are a grafter. And you are a grafter if you accept presents from the dealers from whom you purchase supplies. Some one pays for these presents and it isn't you.

You not only lose the confidence of your employer, but degrade yourself and the honorable profession which you follow. And that is not all. Your actions create a general distrust of all engineers in the minds of employers.

I feel sure that if we, as engineers, would take this view of it, grafting in this field at least would soon be a thing of the past. W. A. E.

Shower Bath and Other Devices.

Editor of the Engineers' Review:

There is not a plant in the country around which there can not be gathered up enough pipe, fittings, etc., to enable any engineer to fit himself up a fine shower bath. No one knows how nice it is to have one in the plant until he puts one in.

Mine consists of 1-inch pipe, as shown in Fig. 1, with steam and cold water connections ½ and ¾-inch, respectively, having a valve in both water and steam supply pipes. The temperature of the shower can be regulated at will while under the shower and when done with the bath, turn off the steam and get a dash of cold water to close the pores of the skin, and then there is no danger of taking cold.

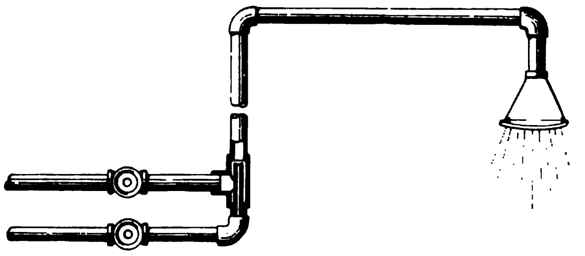


FIG. 1. SHOWER BATH FOR ENGINE ROOM.

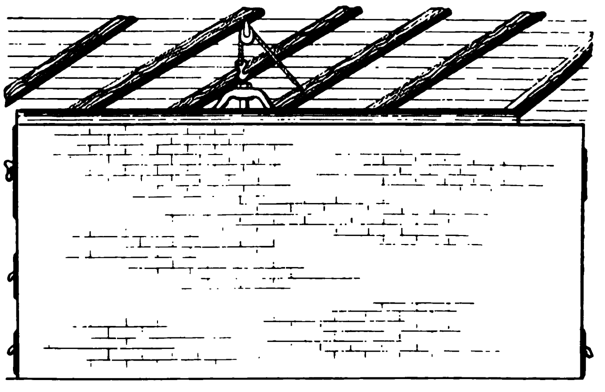


FIG. 2. DEVICE FOR HANDLING MANHOLE PLATE.

I have a splendid bath room 8x9 feet with a partition dividing the room in two sections, one 4x4 feet and the other 4x5 feet, having the shower in the smaller room overhead. The sides are lined with common galvanized sheet iron about 5 feet high and it has a cement floor. In the other apartment I have hat hooks, also a bench along one side of the wall, a mirror,

towel rack, etc., and it is not a bad idea
few coils of pipe under the bench in order
tle steam to warm the room when dressing.
g the inside and using cheap ½-inch ceil-
ll have a convenience and a luxury.

very useful thing that I have is shown in
is a small pulley in the boiler room over the
hole of each boiler, and it comes in handy
ıave the manhole plate out. Just take a piece
l run it through the pulley and tie it to one
es of the manhole or else tap the head and
-inch eye screw; then draw up the head and
ıd of the rope to some convenient pipe while
ıe head to its place and fasten the bolts down
hole braces. This is very handy, especially
hurry to get a boiler cleaned and back into
will also save a lot of burnt fingers.

her, and that is an automatic oiling system

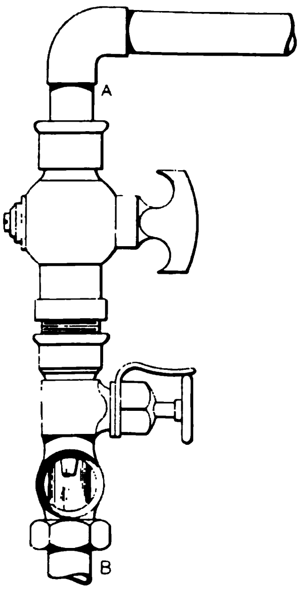


FIG. 3. OIL FEEDING DEVICE.

ısing, as shown in Fig. 3. The connection
he oil tank, while *B* goes to the bearing.

the boys have quite a variety of oiling de-
bed in the Review, but I have never seen
like mine and I will gamble that none work
got some oiling drip valves ⅜-inch, made
ı at the bottom, sight feed, male and female
ıt I screwed a short piece of ⅜-inch pipe
ırings instead of the oil cups to raise the
ıigh enough to give a good chance to see
y are feeding properly or not, and then
the drip and a steam gage cock and then
ıem all up to a sheet iron tank overhead.

g drips have a needle feed so they can be
will. When I shut down I shut off the
cocks above the drips, and in so doing the
s not disturbed.

male and female ends on both the drips
ım gage cocks the amount of joints is re-
a minimum. Should any one of the
rs get stopped up, the union at the bottom
comes in convenient to take that particular feeder out and clean it without disturbing any of the rest, or having to take any of the piping apart.

I have the oil filter handy to the engine and when one of the drip pans gets full I empty it into the filter and when it works through it goes over and down a pipe into a small tank which has a spigot in it. I have also a small pump that was made from a piece of brass tubing, using two 1-inch horizontal check valves. Then all I have to do is to set a bucket under the spigot and pump the oil back up into the sheet iron tank overhead. I also have a bypass around the overhead tank of the oiling system, connected to a 60-gallon tank in which I keep the new oil and empty the oil from the barrel that it is shipped in and use the same pump to fill the storage tank with. The 60-gallon storage tank is also overhead.

Before fitting up the above outfit, I used five barrels of oil yearly, but now I only use one and one-half barrels. The above is only a small part of the actual saving, as it has reduced the labor of running fully one-half in not having to keep a close watch on the oil cups and filling them and filling oil cans etc.; and at the same time it allows the engineer to have much more time to look after other matters and do other repairing. Since I have used this method I get time to do all my arc lamp repairing while the plant is running at night, as well as that of my electric meter, calibrating, etc. And, above all, I have lots of time for good, wholesome reading. J. K. Mercer.

Likes the Letters.

Editor of the Engineers' Review:

I am much interested in the letters published in the Idea Exchange, and many of the kinks therein given have been invaluable to me in overcoming the difficulties incidental to the life of an engineer—albeit a poor one.

Another interesting phase presented by the aforesaid letters is the instructive studies in human nature which they afford and according to Pope's oft-quoted truism, "The proper study of mankind is man."

For example, the recent discussion concerning deception has given us much amusement, and not a little profit. These letters reveal how near akin these latter-day engineers are to the average race of humanity. There are some whose hearts are so big that they would scarce harm a flea. Others there are whose cold, hard natures, righteous though they may believe themselves, cannot or will not see the true nobleness of that man whose kindness leads him to condone the faults of others and, mayhap, sacrifice some portion of his own unspotted robe of righteousness to bind up the wounds of the "halt, the maimed, and the blind."

To close my part of this controversy, I quote as follows from that shrewd student of human nature, Charles Dickens: "There are some falsehoods, Tom, on which men mount as on bright wings toward Heaven; there are some truths, cold, bitter, taunting truths * * * which bind men down to earth with leaden chains."

In getting a line over a stack, I once obtained good results by using a homemade crossbow and arrow. I manufactured a crossbow and arrow which was tipped with lead enough to counterbalance the weight of the flying line attached to its rear end. Thus equipped, I soon had a line over the stack which enabled me to hoist such munitions in the way of ropes, tackle, boards, repair men, brick and mortar as were needed. It was an 80-foot brick chimney in need of some coping repairs.

At another time I was running a small direct current electric lighting plant in a small town in Canada, where I was not only superintendent, chief engineer, etc., but did my own work, including such small items as firing the boiler, oiling the engine, making all repairs, mechanical, electrical, and otherwise, etc. We closed down at 11 p. m., and as we had no storage battery, all who depended on electricity for light were swathed in gloomy darkness at that time unless they had previously trimmed and filled their oil lamps. To notify our patrons that their oil lamps would be required in ten minutes we had arranged a code of signals consisting of three "winks" of the lights caused by opening and closing three times the various branch switches on the station switchboard.

We had on one of the branch lines at that time perhaps 35 or 40, 16-candlepower incandescent lamps, 220 volt about evenly divided among three residences. At one of these residences the main fuses would blow nearly every time the closing down signal was given, though not always. This peculiarity was accompanied by an excessive flash at the contact points of the knife switch on the switchboard when the contact was broken in giving the signal, and also, by a momentary but noticeable forward movement of the station ammeter hand, sometimes advancing as much as four or five amperes.

At the residence in question, the family usually retired early so that their lamps were nearly always turned out before the closing down signal was given. As the sleeping apartments were on the second floor, the lamps were merely turned out at their individual socket switches, no attempt being made to open the main switch and disconnect the entire house system from the mains, as this would have necessitated a trip upstairs in the dark by some member of the family, the main switch being located on the first floor.

I thought perhaps the trouble lay in the meter, which was of the Sangamo inductive type, but was never able to understand why, as there were quite a number of residences in the town in which the conditions were precisely similar, and I had no trouble of that kind except at this particular house.

I wish some of our electrical brethren would advise me through these columns as to the cause of this trouble and its remedy, as I have never since met with anything just like it.

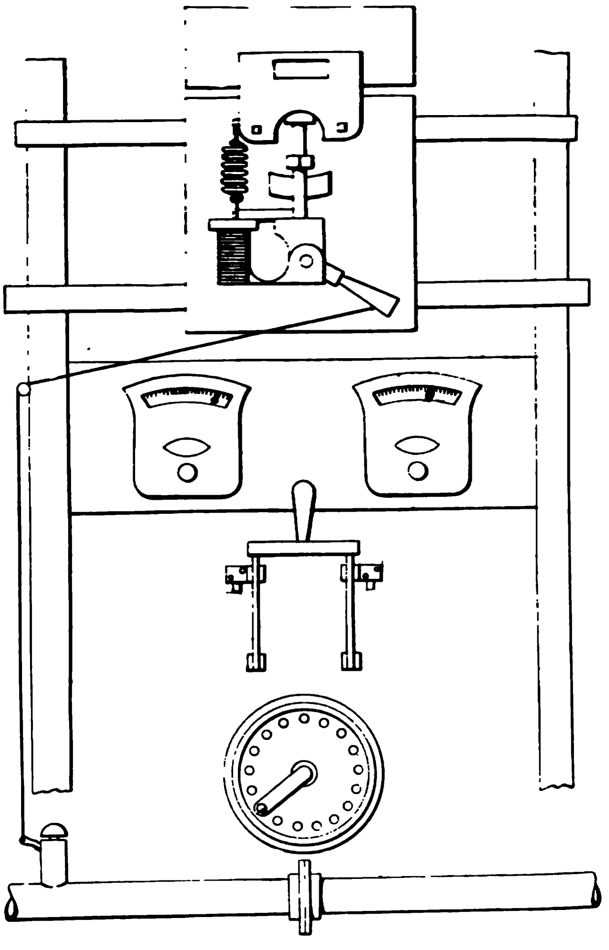
Anon.

A Circuit Breaker Kink.

Editor of the Engineers' Review:

In the plant where I am employed we have a generator supplying current for a number of motors operating underground. In the same plant we have a large air compressor and hoisting engine. As the engine room is large with all kinds of noise, it is very difficult to hear the circuit breaker when it goes out, as the generator and switch board are located in a remote corner of the room. Sometimes the circuitbreaker operates with a loud report and again it will go out so easy that I do not hear it at all. I formerly had an independent 16 candlepower lamp attached to it, but if I happened to be down in the cellar or outside of the building I would fail to see the light. Then there would be trouble from the men in the mine.

I finally hit on the following idea: Directly under the switchboard a steam pipe ran to the engines. To this pipe I attached a small whistle and from the switch to the circuitbreaker I ran a cord with the necessary pulleys. Every time that the circuit was broken the cord was drawn tight and the whistle would howl until it was thrown in again, so that no matter in wha part of the building I was, I could hear when th current was off.



WHISTLE ARRANGED TO BLOW WHEN THE CIRCUIT BREAKER OPERATES.

The illustration shows the circuit breaker. As wil be seen, when the circuit is broken the handle flies u and draws the cord tight and opens the whistle valve causing the whistle to blow. The whistle is locate under the floor of the engine room.

W. E. S.

Pump and Pipe Connections.

Editor of the Engineers' Review:

I have noticed that more or less has been written i the Review regarding trouble with pumps whic the writers seem unable to fathom. Much of the trouble with pumps could be prevented if conditions regarding the piping, etc., were regulated as they shoul be. I have seen many a pump with a suction enterin the water not more than 1½ feet, while it should n have been less than 3 feet, and double that distance would be better, providing the depth of the water allowed. A foot valve should also be placed on the end of the suction pipe, unless the water comes to the pump under a head. A foot valve is a necessity when the lift is greater than 10 feet. With a good foot valve, the pump and suction valves are kept primed when the pump is not in operation and also permits of easy priming if the pump is allowed to run down for any reason.

A good many troubles which arise from the suction end of the pump are due to the absence of a strainer that will prevent sticks, grass, as well as fishes, etc., from entering the suction pipe and clogging the suction valves of the pump. Many times a priming pipe will be found of advantage. This should be connected to the discharge pipe, which, by the way, should have a check and a globe valve in it, the priming pipe connecting outside of the globe valve to the suction pipe. This will enable the pump cylinders and the suction pipe to be prime if they become empty before starting the pump, and will save the knocking which usually accompanies the operation when it is run down and the engineer is endeavoring to get it to pick up the water.

Faulty connections are usually the cause for pumps not acting properly. Sometimes the quantity of water to be pumped is not available or the pump is not located near the source of supply as it should be. A pump to work properly should never be located where the sum of the height in feet, from the discharge valve of the pump to the lowest surface of the suction water, the total friction loss in the suction pipe in feet head and the total friction loss in feet head, due to elbows and tees, exceeds a total of 26 feet. The total friction in the suction pipe in feet head, equals the friction given in the following table (compiled by G. A. Ellis, M. E.), multiplied by the length of the suction pipe line in feet, divided by 100 and multiplied by 2.31 to convert it into frictional head in feet. The frictional loss in feet head, due to elbows and tees is assumed to be the equivalent of the friction loss due to 100 feet of the same size pipe, for each elbow or tee.

The following example will show how this is worked out. If a pump were required to deliver 1,000 gallons of water per minute and the height of the delivery valves above the surface of the water is 18 feet, the suction pipe being 8 inches in diameter and 600 feet long containing two 8-inch elbows, where should the pump be set so as to have easy work in delivering the required capacity?

The height of the valves above the surface of the water	18	feet
Total friction of 600 feet of 8-inch pipe (.94 × 6 × 2.31)	13.03	"
Total friction of two 8-inch elbows (.94 × 2 × 2.31)	4.34	"
Total	35.37	feet

From the above it will be seen that the sum of the three items is greater than 26 and therefore the pump should be set down lower to the water by the difference of 35.27 — 26 = 9.37, or nearly 9.5 feet.

N. B. Greene.

Friction Loss in Pounds Pressure Per Square Inch.

For Each 100 Feet of Length in Different Size Clean Iron Pipe, Discharging Given Quantities of Water per Minute.

Gallons per Minute.	SIZES OF PIPE DIAMETER—INSIDE.														
	¾ in.	1 in.	1¼ in.	1½ in.	2 in.	2½ in.	3 in.	4 in.	6 in.	8 in.	10 in.	12 in.	14 in.	16 in.	18 in.
5	3.3	0.84	0.31	0.12											
10	13.0	3.16	1.05	0.47	0.12										
15	28.7	6.98	2.38	0.97											
20	50.4	12.3	4.07	1.66	0.42										
25	78.0	19.0	6.40	2.62		0.21	0.10								
30		27.5	9.15	3.75	0.91										
35		37.0	12.4	5.05											
40		48.0	16.1	6.52	1.60										
45			20.2	8.15											
50			24.9	10.0	2.44	0.81	0.35	0.09							
75			56.1	22.4	5.32	1.80	0.74								
100				39.0	9.46	3.20	1.31	0.33	0.05						
125					14.9	4.89	1.99								
150					21.2	7.0	2.85	0.69	0.10						
175					28.1	9.46	3.85								
200					37.5	12.48	5.02	1.22	0.17						
250						19.66	7.76	1.89	0.26	0.07	0.03	0.01			
300						28.06	11.2	2.66	0.37	0.09	0.04				
350							15.2	3.65	0.50	0.12	0.05	0.02			
400							19.5	4.73	0.65	0.16	0.06				
450							25.0	6.01	0.81	0.20	0.07	0.03			
500							30.8	7.43	0.96	0.25	0.09	0.04	0.017	0.009	0.005
750									2.21	0.53	0.18	0.08			
1000									3.88	0.94	0.32	0.13	0.062	0.036	0.020
1250										1.46	0.49	0.20			
1500										2.09	0.70	0.29	0.135	0.071	0.040
1750											0.95	0.38			
2000											1.23	0.49	0.234	0.123	0.071
2250												0.63			
2500												0.77	0.362	0.188	0.107
3000												1.11	0.515	0.267	0.150
3500													0.697	0.365	0.204
4000													0.910	0.472	0.263
4500														0.593	0.333
5000														0.730	0.408

Smokeless Firing.

Editor of the Engineers' Review:

I note in recent issues several letters anent smokeless firing and knowing how to fire. I think Mr. Bosworth gets very near the truth of the smoke question when he brings the quality of the coal into question.

I have used Alabama and Tennessee coal, hand fired, on both light and heavy loads, and it invariably smoked. The plant next to mine at that time was equipped with stokers and they made a great deal less smoke than I did, using the same coal and forcing their fires more, but they smoked just the same and could therefore hardly be called smokeless. In my present plant my boilers are forced very hard at times, but the smoke average is about the same as it was at the stoker fired plant mentioned above, only here we fire by hand. The smoke difference is probably accounted for by the fact that we use Pocahontas coal, which is very hard to beat as a steam coal, in my opinion. We have tried a few cars of Alabama coal since I came here, but the difference in price was more than offset by the increased percentage of ash, the smoke, and the difficulty in keeping steam.

I cannot quite agree with Slim Jim in his statement that to be a successful chief one must have "served time" in the boiler room. I do not say that it is not a good thing for a chief to be conversant with practical firing, but I do think there is as little need of a chief having actual experience in throwing in coal as there is of the editor of the Review "serving time" as a type setter.

The man in authority who makes an unqualified success in this world, is the man with the ability to gather around him and keep in his employ good practical men, who are able to do some one thing just a little better than the average. These men look after the details under his direction, and as firing is only one of the details of the plant, it becomes the province of the fireman to make a good showing. The chief never has to "rubber" at the fires to tell if his man is burning coal economically. His log shows him from day to day just what is being done, and if the results are not up to the standard and the trouble is in the firing, it is then up to the fireman to get them there, or make room for a better man.

As Slim Jim says, "life is too short to learn all the details," and it is far better for the chief to have a machinist do his repairs, a lineman do his wiring, a laborer handle his coal and ashes, and a fireman to do the firing of his boilers, than to try to do some one of these things himself, to the detriment of his own work. Of course if a man is to be chief engineer in a very small plant, with perhaps one fireman as his sole aid, he would have to depend on his own resources sometimes, because he personally is expected to look after the details, but the larger the plant the less the necessity of attending personally to these small things. As it is up to him to show complete results, he must of necessity keep his men interchangeable to a certain extent, as it would be no excuse to tell "the powers that be" that such and such things happened while he was down showing the fireman how to fire.

I know of one chief who had one assistant engineer, one head fireman, one pumpman (so called), whose duty it was to keep up the pumps, look after the fan and stoker engines, etc., and four negro firemen. He used to let the three first named men interchange on these three jobs each week, so that each could handle either job he was put upon. This chief personally would have lasted about as long in front of his own furnace doors as the proverbial snowball in hades, but he seemed to get on very well and gave entire satisfaction to his employers, although I have no doubt that at some time during his stay or afterward, some one of the three men may have been "sorehead" enough to talk about the times *he* kept things going right, when the chief didn't know enough.

It is always this way with some men. Because they are lacking some requisite to qualify for a better position, whether it be ability, habits, opportunity, or what not, they are ever ready to complain of the one in authority and blow about what *they* have done and how *they* kept the "kettle" hot, etc., not seeming to realize that all *they* did was in the line of their duty, for which they received payment every pay

They overlook the fact that they are perhaps erated just because of their ability to do this thing. It also seems to escape their notice that world is wide, and if they have the ability they s to think they possess, it would be no extraordir task to take a step higher. I will venture the as tion that there are very few chief engineer's jobs any importance in the country today that are because of friendly influence, or "pull" as it is g erally termed, some of your correspondents to contrary notwithstanding. L. L. Arnold

Firing Without Smoke.

Editor of the Engineers' Review:

Having read several articles on smokeless firing thought I would write a few lines on the subject. have been an engineer for over 30 years. I have b using soft coal for 15 years and have used most kinds in that time. My experience has been that sc kinds will smoke more than others, but all kinds smoke when hand fired if the plant has not boiler pacity enough so that the fires will not have to stirred.

I think a man should understand all the ins and of the boiler room as well as the engine room. It quires skill in both, but the most of the money is sav or wasted, in the boiler room. The engineer shc not only be familiar with all the points in and aro the boiler room, but he should know how to fire different kinds of coal. L. S. Saunders

Fireman vs. Engineer.

Editor of the Engineers' Review:

The letter of T. E. C. on page 29 of the April ber is, to my notion, a little conceited. In all of power plants that I have ever worked it has been my interest to have a thorough knowledge of boil Many times I have had to take on a raw recruit w some of the old firemen were sick or had quit tl positions on short notice. Where would I have b if I could not have handled the boiler plant?

Not long ago the chief I worked for installed a plant which he put in my charge while it was be built. He had me fire the five boilers equipped stokers for three weeks. For three months I ran hoist, compressors and Ideal engine. After that gave me charge of the whole plant. Previous to time I had had 15 years' experience with Corliss gines and hand firing. Did I learn anything? It like starting all over again. His object was to me a thorough knowledge of the whole plant, so I would be familiar with all details.

In regard to the machinist, who is in a class by h self, I would like to ask of what use is a machi without tools and lathes, or what more use would be than the engineer, if he was located 40 miles f nowhere? I don't think that a knowledge of the chinist trade would be a burden to any engineer, I do think that to take charge of a steam plant a ought to start from the boiler room. W. E.

Is Firing Necessary to Success?

r of the Engineers' Review:

see Slim Jim bounces on to T. E. C. who is a inist and has thought fit to adopt engineering as fession. I think T. E. C. deserves much credit cquiring six and one-half years' experience in the ine shop of such a reputable firm as the former son-Houston Co., of Lynn, Mass.

ave in mind an engineer friend who has this week busy constructing an ash conveyor for the room. Next week he will devote his spare to converting two Dean condenser pumps, (steam n) into electrically driven pumps. By doing the , the coal bill will be materially reduced; less on the condensers and a more reliable condensing m than at present will be obtained.

is engineer has been running four Corliss engines gating about 2,000 indicated horsepower. He ne assistant during the day and together with his lement of firemen, things are always running very thly. During my many visits to this power plant e never seen a leaky joint in the steam mains. tion this case in order to show the superiority of eers with mechanical ability, to those who are competent to handle an engine while in good run- condition and who are often named "Stoppers tarters."

e best regulated plants will always be subject eakdowns, and it is only fair to acknowledge that an with engine building and erecting experience, e able to handle the repair of a breakdown, either anent or temporary, without calling for outside ance.

ring the life of an engine, if properly cared for, generally comes a time when the cylinders, or orliss engine, the steam chest, require reboring. e accessories of the plant in question is a boring suitable for this particular engine. Now, as a r of choice between the machinist engineer and l engineer, which will be considered most cap- of handling this job?

ain, say that a boiler is laid off for cleaning. cleaning, the engineer goes through it for ex- ation of seams, plates, etc. On sounding the s, he finds a broken rivet, fractured between the s. Portable forge and all necessary tools are on pot. Would it then be consistent on the part of a le engineer, to impose upon his employers the ex- of calling in a boiler maker to replace a single ?

rsonally I have never been employed as a fire- but always as an engineer. Whether as chief or ant, I have always been willing to handle the l or take a share in cleaning fires, and thus have nly acquired useful experience in firing, but have aided to promote the harmony which should ex- tween men in the engine and boiler rooms.

out a year ago, I had charge of a sub-station and plant owned by a water power company. One some changes were to be made on the high ten- lines and owing to some unforseen occurrence, it impossible to provide current at the sub-station pply the town with commercial and street lights hat night. Therefore, at the last moment, I had s to start up the steam plant, about 500 horse- r. My fireman did not turn up, yet the plant unning just the same, although I had two boilers to fire, beside taking care of the engines, generators and switchboard.

R. L. Fryer.

The Fireman.

Editor of the Engineers' Review:

I am a constant reader of the Engineers' Review and I see that Mr. Forney is of the opinion that he has too much work to do in the engine room. Now we are obliged to admit that the path of a would-be engineer, is not strewn with roses. In my opinion a man to make a successful engineer must start at the bottom and work up, and that bottom is the fireroom. We will again admit the fireman's duties are not easy, for he must come early and usually stay late.

Mr. Forney says he is yet a fireman, but does not intend to remain one. Good for him. We are all glad to hear of the progressive fireman, but he should not complain about being at the beck and call of the engineer, for if he does not intend remaining a fireman, how is he to get his experience to be an engineer, unless he is willing to make himself generally useful around the plant. To be an engineer it is very important part to know how to pack valve stems, file brasses and a thousand other things, which can only be learned by working in the engine room with some practical engineer. It was always my experience when I was a fireman, that the more I helped the engineer the more I learned and the more interest the engineer would take in teaching me. I think Mr. Forney will agree with me that the way to be a successful engineer is to use other tools than shovel, slice bars, rakes, etc.

In Engine Room Chats, No. 15, I agree with Dave Hill that the best way to avoid accidents is to keep a good lookout for things to happen. Look for small defects and leaks and repair them. Remember the saying, "Eternal vigilance is the price of safety." Keep your eye on the little things. Many an accident has been prevented by a timely tap from the hammer or a small twist of the monkey wrench.

Mr. Parker's notes on engineering deception will work very nicely in some cases. For instance, some years ago I was engineer of a river steamer. The pilot declared he could not handle the boat in a certain place, except when the blowing off pressure was carried, which was 170 pounds. If the boilers were carrying 160 pounds he claimed it was impossible to make such a point or bend, unless all the steam the boilers were allowed was carried. I set the weights back on the lever so that the valves would blow at 140 pounds. I noticed there was no trouble in making his points. The safety valve was blowing and that satisfied him. Surely imagination is a wonderful thing.

Using a wrench on the valve wheel is a bad practice, but where is the engineer with many years of practice who has not been guilty of such a thing.

Ex Fireman.

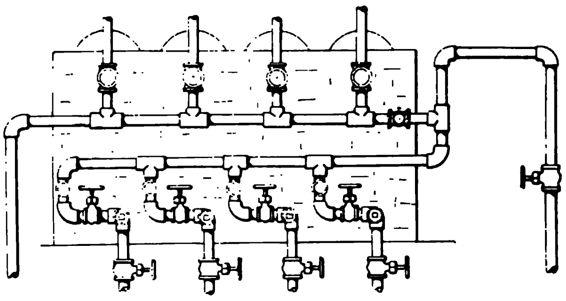
Scale and Boiler Feed.

Editor of the Engineers' Review:

At one place I was employed I had some experience with scale. We had four boilers of the horizontal return tubular type, 64-inch x 16-feet, with 64, 4-inch tubes, a manhole in the front head and on top, and a

2½-inch blowoff pipe connected to the bottom of the shell near the rear head, and provided with a solid disk gate valve.

At the time I took charge the boilers had been in use about five years. The fireman told me he had been there for about a year and had always helped to clean boilers, and that they always did their washing out through the front manhole. On removing the top manhole plate and looking inside I discovered that the space between the tubes for a distance of about 9 feet from the rear head was filled as solid with scale as though it had been run full of babbitt metal.


DUPLICATE FEED PIPES.

Of course the fireman didn't have much to do except shovel in coal and wheel out ashes. After much talk and urgent persuasion I got the superintendent to order a mechanical tube cleaner on 30 days' trial.

It did all that was claimed for it, and considerable more. After using the machine in the boilers it required a man inside several days to remove the loose scale from between the tubes and get it out. We had an iron wheelbarrow holding about 2½ bushels, and the fireman kept a record of the scale taken out of the four boilers. He said 80 wheelbarrow loads of scale, and it ranged from 1-16-inch to 1⅛-inch in thickness.

It was not long until our tubes began to leak in the rear head and the only remedy was to retube the boiler, which we did as follows:

We bought one set of new tubes and put in the boiler that was in the worst condition, and as soon as the old tubes were removed we sent them to the shop and had the burnt section cut off and a new piece welded on. This set was put in the next boiler and its tubes treated likewise, and so on until we went over all of them. This is much cheaper than buying new tubes, and if the welding is properly done it gives good satisfaction.

I never blamed the tube cleaning machine for having caused the leaky tubes, for it was a plain case that all that prevented them leaking sooner was the solid scale formation around them, which had caused them to be overheated.

Of course while we had the tubes out we took advantage of the opportunity and cleaned the shell thoroughly, so when our boilers were retubed they were almost as clean as new.

We tried different kinds of compound with different degrees of success, but by blowing down about every four to six hours during the run and washing every two weeks we were enabled to keep them fairly clean.

Up to this time the feed had entered through the blowoff, but while we were retubing we changed the feed to the top and also connected up one branch from the cold water pump to the old connection at the blowoff, and then connected our new feed line into this cold water line as shown in the sketch. We found this feed arrangement very handy in several ways. We could feed either hot or cold water to any boiler independent to the rest of them.

In case of any derangement to the top feed we could feed through the blowoff while repairs were being made, or in case the blowoff became clogged, we could open it by forcing water through. In case of failure of the boiler feed pump we could use cold water temporarily. A. R.

Pump Packing.

Editor of the Engineers' Review:

The following is an account of a little trouble we had with our oil pump. Our oil system is arranged in the following manner. Two tanks are placed in the basement to receive the oil drain from our three engines, each tank holding about 500 gallons. In the top of the building two tanks of the same capacity are placed. A pump forces the oil from the tanks in the basement to the elevated tanks, the oil returning to the engines by gravity.

Orders were given one of the men to pack the piston rods and put four barrels of oil in the system. This was done and steam turned on, but the pump refused to move. The oil began to get low in the elevated tank and every possible method was tried to make the pump work excepting the right one, and at last it was given up and a little single pump that had been discarded was substituted, which succeeded in keeping the oil supply pumped up until the relief crew came on at 11 p. m. As it was our crew, we started in to locate the cause of the pump not working.

The cylinder heads were put on and the cylinder drain cocks opened, allowing all of the oil to drain out of the cylinders on both sides of the pistons, when the cocks were closed and the pump cylinder filled with water, which solved the problem, as a piece of the plug that closed the bung hole of the barrel raised to the top of the water on both sides of the oil cylinders nearest the steam end. It appears that these two pieces of wood got under the valves in such a manner that the valves on the discharge side could not close, allowing the oil to churn. A most singular thing about it was that the pieces of wood would drop down out of sight when the discharge chamber was removed.

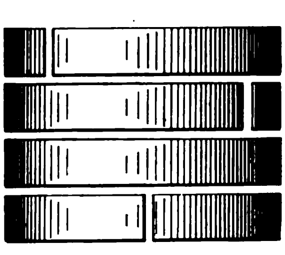


FIG. 1. PACKING PLACED AS IT SHOULD BE.

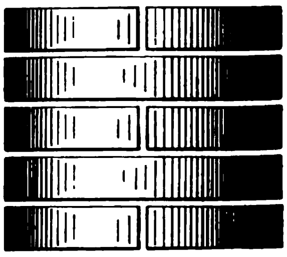


FIG. 2. AS THE PACKING WAS.

We have to renew the packing around our power pump plungers about once every two weeks. The

·s are 6 inches in diameter and require six rings
ıch square flax to each plunger. This meant a
ɔst in the course of a year. I suggested that we
e pumps a fair trial with a larger packing, so
square flax was used. This had to be flattened
ore it would enter the stuffingbox. It was cut
at the ends and placed in the stuffingbox, as
in Fig. 1. It had been previously placed as
in Fig. 2. Four rings of the large packing was
could get in, and this remained in place for 54
ne ring being added to each plunger 10 days
had been packed.

ıt 12 years ago I took a position as engineer in
ı plant that was managed by a superintendent
as in a class by himself. I was informed by
;ineer preceding me that unless I was smarter
.y man that had worked there I would soon be
rocks. Everything went well until I sent in my
ɔn Saturday. He could not understand why the
ısed was not the same each day, although the
as less than it had been at the end of any
s week.

same kick came about the coal and, in fact,
ing that did not tally each day the same, al-
I made a saving of $20 the first week. It was
to me that the engineer preceding me practiced
ɔn as to his reports. The superintendent made
ice of taking my fireman away to some other
ɔr a short time without saying a word to me.
sult was that the steam pressure would drop
ick would be made by the machine tenders and
ı we furnished power for. At the end of the
week I made up my mind to settle our differ-
ce and for all, so we had a talk on the matter,
ıld him that I was through if I wasn't allowed to
the plant as it should be.

: that day until I left, two years later, he never
ault. W. A. Dow.

Foaming Boilers.

of the Engineers' Review:

ıing boilers is a trouble which is more or less
ı, the cause of which arises from several
, chief among which is the condition of the
nd the nature of the water. An instance which
ɔearing on the subject comes to mind in the
a new boiler, 72 inches in diameter which gave
for several days after it was started up. The
r, who had not had much experience with new
could not understand where the trouble lay
; inclined to think that there was too little steam
The boiler, however, foamed because of oil,
ınd dirt that had got into it during its course of
ction. The way to do in a case of this sort,
ɔw down frequently, changing the water in the
.s often as possible, and the trouble will soon
ar. The smaller the boiler the sooner a remedy
effective.

wonderful the different kind of rubbish that
lect in a boiler, especially a new one, such as
ɔf board, or old rivet kegs that have been used
men to sit on during the course of construction.
waste and other small articles are frequently
ɔilers, which if not removed by the engineer in
before getting up steam, may cause trouble,
ly in the case of oily waste.

The way to do with new boilers as a precaution to foaming, is to blow down as far as it is safe, and then pump up and blow down again.

Another thing to be watched is that no rubbish is left in the boiler. In order to prevent this the engineer should either go in himself or send some one in whom he can trust, to collect all such matter that has been left in the boiler before the handhole plates are put on. Before the boiler is closed up entirely, someone should get into it and remove all such sticks, etc., that are floating on the water. If this is not done, they may get into steam pipes, etc., and cause trouble.

Some new boilers never foam at all. Others will foam for a long time after being put in use. If the boiler is clean and in good order, the trouble probably arises from hard firing and small steam space. Foaming when it occurs in a serious nature should be checked by closing the draft, and running the feed pump at a higher rate of speed. There is not only danger of burning a boiler when foaming occurs, but also the liability of knocking out a clinder head, by water carried over from the boilers. When bad foaming occurs, the engineer should take immediate steps to slow down the engine and deaden the fires.

Carrying water too high in a boiler is frequently a cause for its being carried over to the engine. I recollect a few years ago while running in an electric light plant that when I came on duty I found the boilers with about three gages of water in them. Of course this is a little more than engineers are in the habit of running with, but as it costs money to pump and heat water, I did not feel like blowing it out for the mere sake of getting rid of it, and therefore decided to start with the water higher in the glass than it should have been. Under ordinary conditions things might have passed off all right, but we had not been started up more than five minutes before a heavy short circuit came on the line, which caused the engine to labor extremely hard and over came the water in a deluge. By the time the engine was slowed down and things had resumed their normal condition there was less than two gages of water in the boiler which shows the enormous amount that had been taken through the engine.

This engine was a Sioux City Corliss, equipped with relief valves on each end of the cylinder, which undoubtedly saved the cylinder head in this instance. Since that experience I have never started my plant, when the water was too high in the boiler.

Harry Teeman.

Engineering in Egypt.

Editor of the Engineers' Review:

This letter is to let the readers of your paper know how engineering is carried on in a general way in this part of the world. At present I am employed as chief engineer of the Egyptian Cotton Mills at Cairo, Egypt. We have machinery from several parts of the world, as there is not much machinery built here, but plenty of repairing done.

The machinery in our mill was all built in England. The engine is a cross compound connected to a jet condenser and will develop 1,100 indicated horsepower, when full load is on. We take water from the Nile river which is ¼-mile from the mill.

The flywheel is of the drum-head type and runs four pulleys by rope tranmission. We furnish our own lights. We have a dynamo that runs from one of the line shafts while another is run by a small engine in the machine shop.

We have a Green fuel economizer and often have the feedwater up to 302 degrees F., but generally 280 degrees. So far there has not been any coal in this country. It all comes from England, Wales and Scotland. There is more Cardiff coal used than any other kind, about 330,000 tons coming to this country yearly. We burn Cardiff coal and pay $6 a ton for it at Alexandria. Our spindle oil costs 32 cents per gallon, machine oil costs 36 cents per gallon, cylinder oil costs 36 cents per gallon and engine oil costs 62 cents per gallon.

This mill has been running four years. There is also one at Alexandria that has been running about the same length of time. They are the only cotton mills in this country with the exception of some very small ones, run by the natives.

Most of the railroads here are run by the government, on the English plan. The coaches open on the sides. The locomotives come from England, Scotland, France, Germany, Belgium and America. Most of the American engines were built at the Baldwin Locomotive Works, Philadelphia. All roads here use vacuum brakes, as they say the air brake is too complicated. All of the engines, but the American, are inside connected.

It is enough to break a man's heart to think of working around those inside connected engines, although they seem to be good engines. Some of them are 55 years old, with the old iron boiler. The English people built about the same style of an engine 50 years ago as they build today.

The street cars are after the French plan. The machinery in the power plants is of French and Italian build, while some of the generators come from America.

The machinery at the water works is all French build, as is also the machinery in the ice plants. The machinery in the flour mills is all Italian build.

The street rollers are of French and English build. The traction engines, steam ploughs and threshing machines are most all of American construction. Most of the irrigating machinery is built in England. A good many oil and gas engines are used here, as fuel is expensive.

They are just beginning to develop farming on a large scale. Things are growing better every year in all kinds of business. This summer they are building another bridge across the Nile.

The first winter I was here I had a position as chief engineer on one of the passenger steamers that run up the Nile, as far as Assoun, 583 miles from Cairo. We would carry tourists and stop at all of the principal places. There are three companies that run steamers on the Nile, besides many private steamers, and steamers that belong to the royal family.

Cook's steamers are all side wheel with diagonal engines. The Anglo-American steamers are stern wheel with feathering plates. The Tupekea steamers are side wheel. They have several screw propellers. Some of their side wheel boats have vertical oscillating engines. All of these companies have freight steamers and barges.

The condensers that are used on the various stea are surface, jet, keel and ejector condensers.

About four months ago a small boat that belo to the Anglo-American company blew up and k all on board, but they were carrying no passenge the time, although there was a woman and child k on another boat that was close by.

There are plenty of engineers in this country carry no license, and I have never seen a boiler in tor since I have been here. Geo. W. Po

Cairo, Egypt.

Expanding Boiler Tubes.

Editor of the Engineers' Review:

Having just completed the job of putting in a new tubes into my boiler, the thought occurred tc that there was a time when I did not know how t this job and that possibly some of the readers of

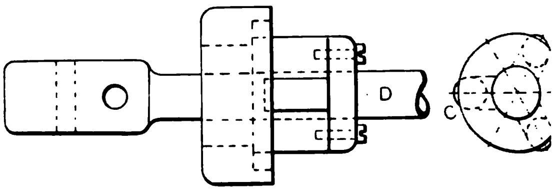


FIG. 1. ROLLER EXPANDER.

Review are not yet familiar with the method use

Various methods have been employed for ge tubes steam and water tight. A tool largely us shown in Fig. 1, which is the type I have and is easy to use. It is known as the roller exp and enlarges the tube by a rolling process. It co three steel rollers as shown at *A*, *B* and *C*, whic held in the seats of the body, and are revolved forced outward by a slightly tapered mandrel sho *D*. I find the roller expander a good, serviceabl efficient tool, but a man wants to stop rolling a proper time, because with it a tube can be rolled even to a dangerous state.

The method I pursue in expanding tubes is a

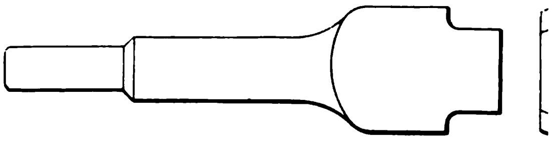


FIG. 2. BEADING TOOL.

lows: The tube is located in the tube sheets, allo between 3-16 and ¼ inch to protrude, and wit roller tool is then rolled to a tight fit, and the ends beaded. When the ends are beaded, or t over, the tool shown in Fig. 2, which is practic caulking operation, is used, and the job is finish in a workman-like way by a tool shaped like F which is held in one hand and struck with a ha held in the other. I like the tool shown in Fig. best, because the metal being cold it is necessa gradually draw the ends of the tube down and a in order to make a smooth job.

rounded edge is shown in Fig. 4 at *E*. Fig. 5
another method of expanding a tube into a tube
Here it will be seen that the tube has a bead on
side of the tube sheet shown at *F*. The tube

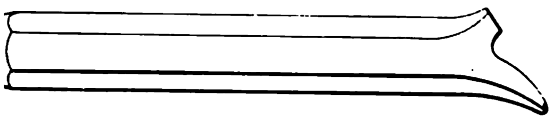
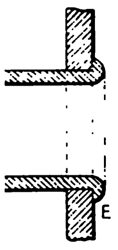


FIG. 8. ANOTHER TYPE OF BEADING TOOL.

g the appearance on both sides of the sheet as
1. It is doubtful if there is any great advantage
panding a tube in this manner, although there are
who think to the contrary.
ave known of cases where new tubes have been
a boiler where the ends were left sticking out as
in Fig. 6. There are several objections
st this way of doing the work, as in the first place
be is deprived of a great deal of its holding power



. BEADED
TUBE.

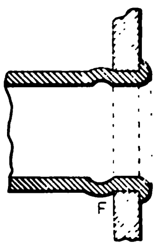


FIG. 5. BEADING ON INSIDE OF TUBE.

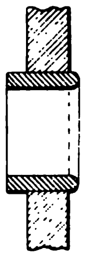


FIG. 6. TUBE EXPANDED BUT NOT BEADED.

ing as a brace to the boiler head, which is an im-
it thing in boilers of the return tubular type.
ier reason why a tube should not be left this way,
ause the end is exposed to the flame from the
ce, and not being protected by water is soon
d, which not only ruins the tube, but makes it a
of danger. A. C. Struckfus.

Water as a Power Producer.

r of the Engineers' Review:
gineers in almost every country are working out
es for converting the power of falling water into
ical energy. It is a source of power towards
engineers will always look with longing eye.
we find energy stored up for the simple taking.
osses from combustion, condensation and all other
which prevent more than 10 per cent of the
ble energy stored up in coal from being utilized
steam engine in producing power is not en-
ered.
ing recent months considerable has been said in
ess and technical journals about the destruction
grandeur and beauty of our water falls. There
thout doubt, considerable truth in these state-
, and spots of extreme beauty are in danger of
spoiled, if not wholly destroyed, by converting
ater power into electrical energy. It is not im-
ve that this state of affairs shall come about, and,
ver, it is not at all a necessity. In many instances the conversion of the water power into electrical energy requires only a small part of the total volume of water flowing over a falls to produce the necessary energy in the power plant; the flow of water not being perceptibly diminished over the natural falls.

In tapping a waterfall for water the action of the falls is not interfered with in the least, the volume of water necessary for the production of power being merely diverted from its original source to that of the turbines, through artificial channels and penstocks.

Several schemes have been adopted in America for the development of electric power from water falls. Notably the immense power plants at Niagara and on the Pacific coast, in the Sierra Nevada range of mountains. From the water supply of this range of mountains, streets and buildings are lighted, street cars propelled and manufacturing establishments are operated, one company producing something like 50,000 horsepower.

The regulation of these water power plants is something which is almost past belief. It is said that the governors on the water turbines are so sensitive that when a street car is started, or stops 130 miles from the power house, the electric governor responds instantly to the change of load, thus allowing the turbines to receive only the exact amount of water for the required load. When the demand for water is less than the maximum, the superfluous water is thrown into the tail race. When the full power of the dynamos is required, not any of the water is allowed to escape until it has passed through the turbine where its velocity is spent.

In the case of the Sierra Nevada mountain plants, some of them impound the water at an altitude of 9,000 feet, which being turned into electrical energy furnish electrical power through cables to an area of about 26,000 square miles.

Over 175,000 horsepower has been developed at Sault Ste. Marie, Canada, from the local rapids, which in the form of electricity is supplied to the largest and most important industries in that section.

The Winnipeg river, which is dammed across at Rat Portage, gives a head of about 20 feet, and a storage area of about 2,000 square miles, having a capacity of about 30,000 horsepower.

At Niagara there have been established power companies to the extent of about $20,000,000, and over $3,000,000 has been expended for power development by companies having franchises. When the work of producing the total amount authorized is completed, the falls will be giving up 424,000 horsepower, and an additional sum of $17,000,000 will have been expended, making a total investment of $30,000,000.

The Lachine rapids in the St. Lawrence River, just above Montreal, and Chambly on the Richelieu River, supply power and light to the city of Montreal. The streets of Quebec are lighted and the street cars are operated by electricity generated at the power station located at Montmorency falls.

The Chaudiere River at Ottawa has a fall of about 40 feet at the lowest stage of the river, which has developed about 8,000 horsepower. It is stated that within a radius of 50 miles from Ottawa there is available waterpower energy equivalent to 900,000 horsepower. It is estimated by those who are in a position to know that the St. Lawrence systems place 10,000,000 horsepower at the disposal of Canadian industries, while the power of Niagara is estimated at 5,500,000 horsepower.

Many engineers are of the opinion that steam is the only power that amounts to anything, but the above figures should give a different impression. This is doubtless because the engineering papers confine their articles to steam power and steam alone. E. Akers.

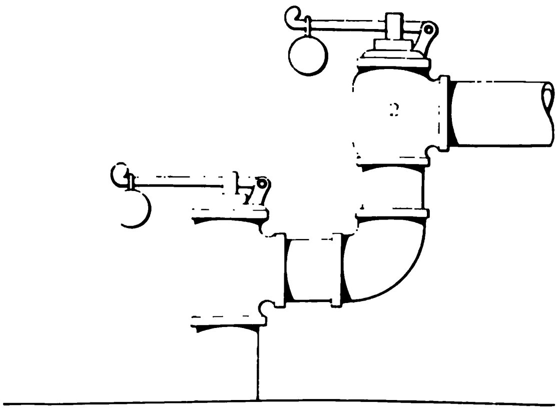
That Safety Valve Puzzle.

Editor of the Engineers' Review:

You will doubtless receive several letters in answer to the one by Guy B. Cooley in the August issue.

Mr. Cooley's question deals with two safety valves and the problem is as to what pressure No. 2 valve will blow off at, if both valves are set to operate at 100 pounds. From the looks of the illustration one could take the valves as either the pop or ball and lever type, in which case there would be a difference as to the manner in which the steam would act upon valve No. 2. I believe the valves will blow off at practically the same pressure.

Arranging the valves as shown in the illustration and attached to a boiler carrying 100 pounds of steam, with both valves set to blowoff at 100 pounds pressure, what will valve No. 2 blowoff at? The assumption is that both valves are of the same make and will operate at exactly the same pressure under ordinary circumstances. This being so, there is no doubt but that valve No. 1 will blow off at 100 pounds as soon as the steam in the boiler reaches that pressure. Steam will discharge at a velocity of 902 feet per second at that pressure, and that is the velocity it will escape from the boiler when valve No. 1 operates. At 100 pounds pressure the discharge of steam per minute per square inch of opening is 98.6 pounds or 16.3 pounds of steam per second. If the valve has an area of 5.5 square inches there would be 89.6 pounds of steam escaping each second.



WILL VALVE NO. 2 BLOW AT 100 POUNDS PRESSURE?

Now if valve No. 1 operated when the steam pressure reached 100 pounds the valve disk of No. 2 valve would have 89.6 pounds of steam forced against it at a velocity of 902 feet per second at 100 pounds pressure. This should be sufficient to open the valve and allow the steam which is escaping through safety valve No. 1 to escape to the air. With both valves open there is no reason why the steam would not escape as long as the pressure remained at 100 pounds.

I do not see as there will be any back pressure, because as soon as valve No. 1 opens the steam will rush into and fill the space between it and No. 2, and the valve then becomes a balanced valve in case the second valve does not open. The only thing which will happen, in case No. 2 valve does not open, will be that the weight on No. 1 will close the valve when the steam between the two valves is equalized. The result would be that valve No. 1 would open and shut as the pressure varied on either side of the disk. I have no doubt but that the force of the escaping steam would be sufficient to operate both valves when it reached a pressure of 100 pounds. I can't see where back pressure can have anything to do with the operation of valve No. 1. If one valve will operate at 100 pounds pressure, the other ought to. When valve No. 1 allows the steam to escape at 100 pounds pressure, I can't see why No. 2 valve won't allow steam to escape to the air, because the pressure exerting a force against its disk will be 100 pounds.

In case the valves are of the pop type the same principal holds good. There is this difference, however, the disk is held open after the valve has operated until the pressure drops 3 or 5 pounds. There is nothing to prevent the steam from operating against the disk of valve No. 2 and cause it to blow at 100 pounds pressure. I fail to see where one can figure it out that the second valve will require 200 pounds to operate it.

Doubtful.

Rivets, Patches and Joints.

Editor of the Engineers' Review:

The following sketches, which were made from boilers I have recently seen, were taken from my note book. The first illustration presents a joint showing defective rivet heads which are altogether too thin and flat. This was doubtless brought about because the rivets were too short in the first place, therefore not allowing length enough to rivet over as they should have been. This was probably due more to carelessness than to any other reason. A rivet should have the same strength at both ends and the only way that this can be accomplished is by making the two heads as near alike as possible. In ordinary practice it is generally considered satisfactory when the two heads contain an equal amount of stock and are so shaped as to give a proper bearing against the plate.

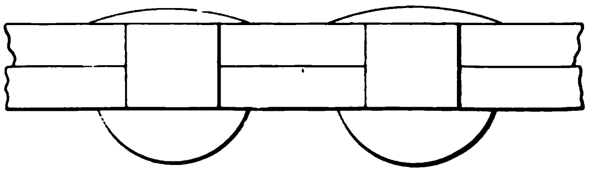
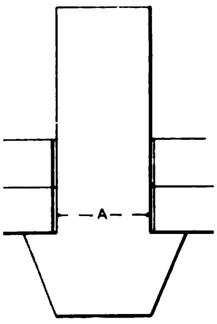


FIG. 1. DEFECTIVE RIVET HEADS.

In riveting a joint a certain amount of material in the rivet is used to fill the hole, as the diameter of the hole is usually 1-16 of an inch greater than that of the rivet. This is shown in Fig. 2, at *A*. It is a general practice to allow ⅛ of an inch in length of the rivet shank to allow for filling in the space in the rivet hole, although this may vary somewhat with the diameter of the rivet and the thickness of the plate through the rivet is driven. The greater part of the ıat an allowance must be made for, is that of ıd, in order that it shall have the same stock original head. It is usual to allow material in the section of the shank which is to form the ead to be about 1.63 times the diameter of the vhich when riveted over will form a head sim- that shown in Fig. 3. The length of the rivet



LENGTH OF RIV-
LOWED FOR FILL-
OLE AND FORM-
RIVET HEAD.

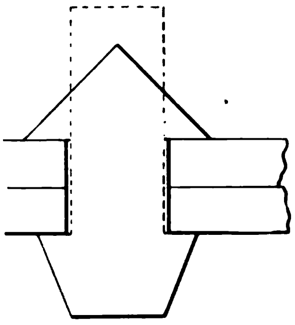
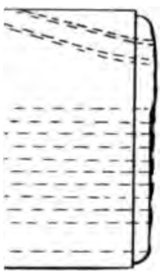


FIG. 3. PROPERLY SHAPED RIVET HEAD.

erefore, be 1.63 + ⅛-inch, plus the thickness plates forming the joint.

4 shows a bulged head on a boiler which I saw and examined. It will be seen that the t portion of the bulge is above the tubes al- it extended down to nearly the second row e top. This boiler was in operation, although taken out shortly afterward, when one of the plit. If it had not been for that, doubtless the vould have been made to do duty for a longer The cause of the bulge in this case was due broken braces.

no uncommon thing to find boilers with the lged even below the tubes, showing that a very rain had been placed upon the boiler head.



ULGE CAUSED BY
KEN BRACE.

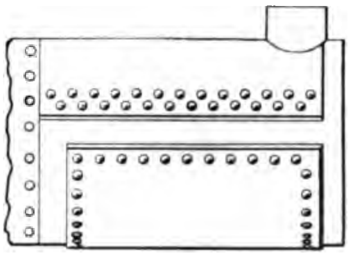


FIG. 5. SINGLE RIVETED LONGITUDINAL SEAM IN PATCH.

5 shows a boiler constructed with two sheets. e seen that the fire sheet had been patched and patch was very near as large as the original s it extends around both sides about an equal . Another thing noticeable is the fact that gitudinal seam of the patch is single riveted s a wonder that it held at all. This boiler has been discarded also and is not in use at the present time, which will doubtless prevent a newspaper notice of another boiler explosion.

Fig. 6 is a sketch of boiler joints which were recently observed on a boiler, which have nothing to commend in them and everything to condemn. Such patching illustrates to what lengths a man will go in order to save a few dollars.

I read your article in the April issue relative to the Brockton boiler explosion, which states that the law is in the hands of the legislature relative to the restriction in the use of lap joint boilers. I would suggest that something be amended to the bill prohibiting such bungling jobs as shown in Figs. 5 and 6. If such criminal practice could be abolished we would without doubt read of fewer boiler explosions.

E. C. Kennedy.

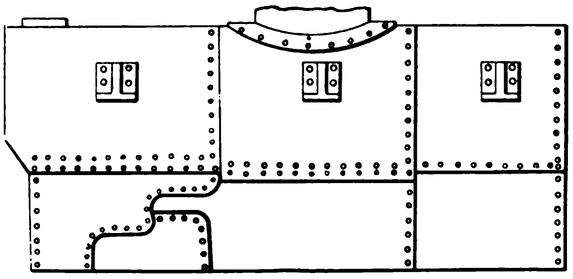


FIG. 6. A BADLY PATCHED BOILER.

Recommends an Incubator.

Editor of the Engineers' Review:

Not long ago I received a corker from a fellow who came into my engine room and said: "Dad, have you an incubator on your engine?"

"A what? An incubator! I have not, nor do I have any use for one, as I am not in the poultry business."

Well, he told me I was about 100 years behind the times, and that he was not born yesterday and had had two years experience firing and that no man could run an engine right without an incubator. I asked him if he didn't mean an indicator and he concluded that was it. I hope no brother engineer will make a mistake and put on an incubator, unless he wants chickens flying around the engine room.

Another far-sighted fellow said a few days ago that the time was not far distant when engineers would be a back number; that there would be no further use for them because electricity will be used altogether. "But," I said, "how will we get the electricity?" He had not given that part much thought.

C. H. Prescott.

More About Compression.

Editor of the Engineers' Review:

After reading the several letters on compression I can't see that anyone has answered the question that I asked in the December issue of the Review: "Does compression consume coal?" I have since come to the conclusion that excessive compression is a heavy loss.

Just enough compression to bring the moving parts to rest is what is required. This fills up the clearance space to some extent and when the valve opens, it does not take as much live steam as if there were no compression. The piston, crosshead and rod must be stopped before they can start in the other direction. If we have no compression to stop them, part of the stored energy of the flywheel is used to bring them to rest and to get them started on the return stroke.

This is a loss, but if we use steam that has already done its work to bring the moving parts to rest, we have not lost anything, but have saved live steam by filling the clearance space before it is admitted, and have also saved the useful energy stored up in the flywheel.

Mr. F. L. Johnson is wrong when he advocates no compression at all. This would do for an engine running 30 revolutions a minute, but it will not do for moderate or high speed engines. W. J. D.

Compression.

Editor of the Engineers' Review:

There has been considerable talk in the Review of late about compression. Compression is all right if it occurs at the right time and from the proper source. We need compression to bring the reciprocating parts of an engine to rest. The amount depends on the conditions of each particular engine.

Cushioning with exhaust steam is the proper thing to do, as the clearance space is partly filled, thus reducing the amount of live steam used. This must be a saving in itself.

Cushioning can be easily done in the four-valve engine, and to a certain degree in the single-valve automatic, or slide valve engine, by exhaust lap on the valve.

In the four-valve slow speed engine, I like to see compression enough to bring the parts to rest easy and the bearings just loose enough to prevent heating or undue friction. The steam valves should be just a trifle late so the thrust will not come on a dead center, but just as the crank is at the point of passing from the center. Then the work comes on easy and at the proper time.

If we have a high speed engine the steam must be admitted quickly, so as to get as near the boiler pressure in the cylinder as possible.

I cannot agree with those who say that compression is a source of loss and is not necessary for smooth running. F. L. S.

Still More About Compression.

Editor of the Engineers' Review:

I believe most readers of the Review are tired of the compression subject, since most of them are of the same opinion in a general way, with the exception of a few that must be on the contrary side as in all other questions that arise, yet I notice one of the correspondents thinks I might give my views on the subject.

Even though Mr. Wentzel states that he does not see that W. J. D. refers to the low pressure cylinder, I am of the opinion that Mr. Wentzel, as well as myself, would deduct from that article that he did refer to the low pressure cylinder of a cross compound condensing engine, inas-much as W. J. D. says it was the
low pressure cylinder which was flooded with w
and damaged.

From this fact I infer that the damaged engine
the one that pounded. I further note that he
tions the injection valve, therefore it appears to
that the engine in question was the low pressure
of a cross compound engine running condensing
it was with this idea in view that I made the comm
which appeared in the June issue. I still contend
if there is anything to compress it is the vacuum.

Others' experiences may have been different

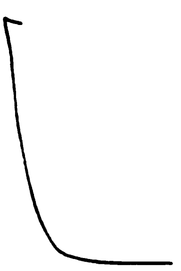


FIG. 1. ADMISSION CURVE.

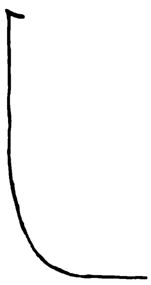


FIG. 2. COMPRESS
CURVE.

mine in regard to compression on the low pressure
of a cross compound condensing engine, but I
not been able to get what I considered the proper
ion from compression of the vacuum with the ex
valve adjusted to give the proper release, and t
fore believe it to be an advantage in this case, to
the engine just enough lead to produce a gradua
mission curve, which some would call compres
Figs. 1 and 2 will show the difference, Fig. 1 bein
admission curve and Fig. 2 the compression curv

I believe in compression if there is a proper am
of it, no more, no less. Each engine has its own
ditions to take into consideration and there is no
of telling what is the proper amount in a general

Fig. 3 is a card taken the other day, which I
presents an ideal compression curve and one

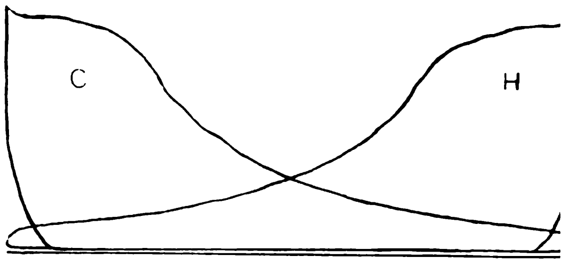


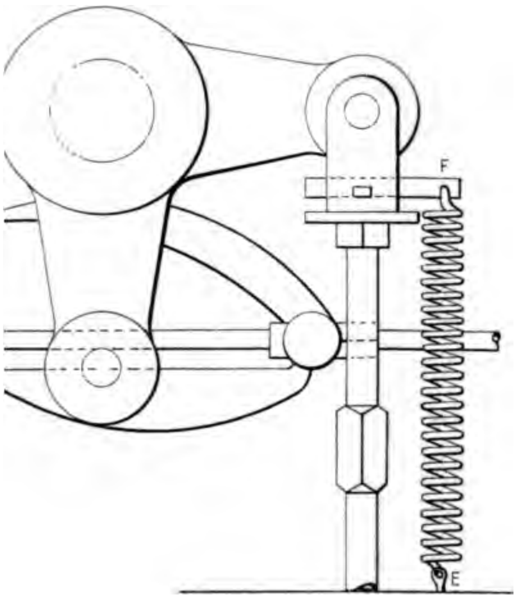
FIG. 3. IDEAL COMPRESSION CURVE.

can not be obtained from many engines. Wh
call particular attention to is the lateness of exh
closure and at the same time raising the compre
to a little more than half the boiler pressure.
card was taken from a Buckeye engine that has be
constant operation day and night, except Sundays
16 years, and has never had the valves refitted or
redressed. Furthermore, the card is the first t
from the engine on the date taken, and no adjustm
of the valves had been made for at least six mo
previous. C. B. Risle

Spring on the Valve Crank.

of the Engineers' Review:

following is a little kink that may be old to but I have never seen it used before. One day : my dash pots refused to close the valve. I l around and found an old spiral spring and an t, and rigged them up by boring a hole through ıor and put the eyebolt in it. Then I fastened d of the spring to it and fastened the other end spring to the key *F* which keys the dash pot rod valve crank. After drawing the spring tight to a good tension, the valve worked all right.



ING ATTACHED SO AS TO CLOSE THE VALVE.

ɜn I shut down that night I took up the dash d found the valve broken. I sent for another n with the spring on until it came.

H. Armstrong.

Another Governor Pounds.

of the Engineers' Review:

letters in the August issue answering Mr. Stedre interesting, but they don't seem to touch on ɜe at all. I have a little engine operating at a of 250 revolutions per minute and belted to a current generator. All the engine does is to ı light for several buildings. It runs smoothly ɾeral minutes and then begins a knocking that ıgh to make Bill B. Banger nervous.

engine does this more specially when the load :. At all events, the load is not one that changes ıly, but gradually comes on and as gradually ff. That the noise is due to the action of the s evident from the fact that by opening the drip on the cylinder of the engine the noise diss. I have tried adjusting the valves on the ɜr a little each way in order to advance the r decrease it as I thought was best, but I have ɜn able up to the present time to make any imıent.

n get the engine to operate all right when the drip valves are open, but that is only wasting steam which I do not wish to do. I would like to have the opinion of engineers as to what is the best thing to do under the circumstances.

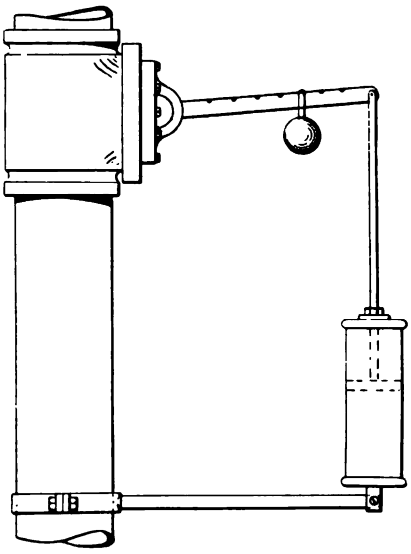
Regarding tramp engineers, I am of the opinion that Bill B. hit it about right when he described them as he did. His description fits the kind we have out in this part of the country (Iowa), many of whom have had experience with threshing engines only. When the season is over, they start around the country trying to get into some plant, and in their visits we often run up against some funny specimens of engineers.

Helpless.

Dashpot for Back Pressure Valve.

Editor of the Engineers' Review:

After reading over the many new kinks and homemade devices, I have concluded to illustrate a dashpot I have for a back pressure valve. As is well known the valve with the lever and weight are noisy, especially where the load is suddenly changing, as the weight will fly up and down with a great deal of force: The dashpot is made from a piece of 1½-inch tubing, about 8 inches long, with a cap on each end. I tapped out the top cap for a ½-inch pipe and took the stem out of a ½-inch globe valve, also the part that screws in the body of the valve, and screwed it in the top of the cap, which made a good guide and stuffingbox for the plunger-rod of the dashpot.



DASHPOT ON BACK PRESSURE VALVE.

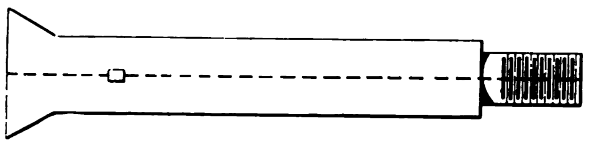
The plunger fitted fairly tight, so the oil could pass by, but with a retarding movement, according to the thickness of the oil. In this way the weight moved up and down freely, but with a steady motion and not with a jerk that is so injurious to the valve seat.

G. B. W.

Why the Pin Heated.

Editor of the Engineers' Review:

Some time ago a wristpin commenced to get hot. Oil did not reduce the trouble any and it finally got so hot that I had to shut down the engine. I removed the brasses from the pin, scraped them to a good fit, and then covered the pin and brasses with cylinder oil and started up. In an hour the pin commenced to get hot, with the oil cup feeding as fast as it could. Again I had to shut down the engine, and by examining the pin more closely this time I found that the oil did not go to the box, but through the wristpin, which was caused by the plug working out as shown in the illustration.



WHERE THE PLUG WORKED OUT OF THE PIN.

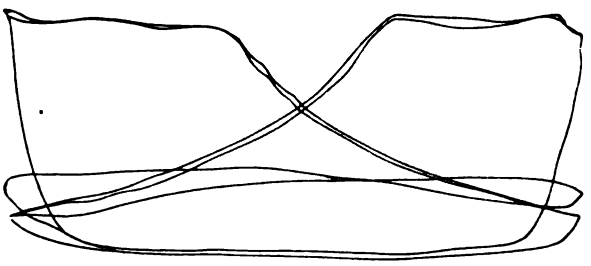
For some time I had noticed a lot of oil on the bottom slide which I could not account for, but I never surmised that the plug had worked out of the pin. After the box was again scraped, I put the plug back into the pin and had no further trouble.

H. Jahnke.

A "Freak" Indicator Card.

Editor of the Engineers' Review:

The other day I had occasion to call at a large plant run by a particular friend of mine. During our interview he showed me the accompanying "freak" indicator card, which he had taken from a cross compound Corliss engine a few days before. Can any of your readers give the cause of its peculiarity?



A FREAK CARD.

R. L. Fryer.

Sees Things in a Different Light.

Editor of the Engineers' Review:

J. B. Harland in his letter "Engineers, Wise and Otherwise," upholds an engineer who practiced deception in changing the speed of a fan engine according to the orders of the superintendent and getting reprimanded for it by another. Now this engineer was in no way justified in adopting the plan he did. He slowed his engine down and when he noticed the absence of the click at 250 revolutions a minute he desired to keep it there. He then had trouble in the form of a loose counterweight. He deliberately loosened the counterweight, to cause a click and fool superintendent No. 1, who must have been rather slow or he would have asked for a speed indicator and ascertained the speed, click or no click.

He also states he is a stranger to back pressure i an exhaust line, and believes there is no back pressure on a 175 foot line of exhaust. I think he would be wiser if he tested that steam gage. Then he tells of trying to run two engines and furnish steam for them with boilers that would not furnish steam for one. A man with 40 years' experience should know that if he could not keep steam at 110 pounds for one engine, he surely could not keep it at 70 or 80 pounds for two engines with the same load, and if one engine would use more steam than he could furnish, it ought not to have taken much figuring to find that two engines would use still more.

S. Kip.

Compounding of Steam Engines.

Editor of the Engineers' Review:

Much has been said and written regarding steam engine economy and although it is an admitted fact that the compound engine is more economical to operate than the single cylinder, we hear very little about it. The majority of engineers will admit that in a single cylinder engine, using steam with a high ratio of expansion, there is of necessity a certain loss of heat units, and that the loss is in a direct ratio with that of expansion, the cause of which is that the walls of the cylinder are exposed to the atmosphere.

There is a definite relation of temperatures to pressure and, therefore, it is evident that the walls of the cylinder during each stroke of the piston will be reduced in temperature to a great extent. Just how much, however, it is difficult to determine.

The principle of compounding consists of dividing the expansion into two or more stages and carrying it out in the same series of separate cylinders, with a small range of temperature in each cylinder. It is well understood that the initial pressure of a high pressure cylinder falling through a small range of temperature, suffers little from condensation, and whatever there is upon being released is reevaporated and exhausted into the receiver of the low pressure cylinder, in the case of a compound engine, instead of into the condenser. This reevaporation exerts a pressure on the large area of the low, or intermediate, piston, although it will increase the back pressure on the high pressure piston. The gain by compounding is about 25 per cent.

In calculating the area of the low pressure cylinder the area is calculated as though all the power were to be developed in that cylinder, and when the diameter of the low pressure cylinder under such calculation proves to be excessive, it is divided into two cylinders, which gives us the triple expansion engine, with the same condition existing as with the ordinary compound.

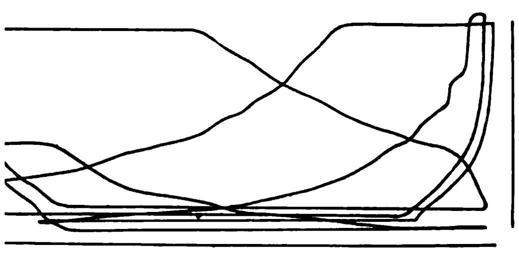
The pressure that is allowed to be carried on the boiler will determine whether the different types of compound engines can be used to advantage or not. The ordinary compound engines may be used to advantage carrying steam from 90 to 125 or 130 pounds, the triple expansion from 130 to 180, while the quadruple from 180, upwards.

The triple expansion engine is not to be recommended for stationary practice except in instances where there is plenty of water for condensing, and where the load is practically the same at all times.

W. E. Stedman.

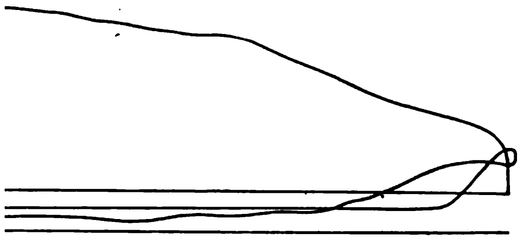
What a Little Change Did.

f the Engineers' Review:
ards illustrated below were taken from a Lake



CARD PRODUCED AFTER TRYING YEARS TO GET GOVERNOR REGULATION.

ight compound condensing engine, operating railroad work. Card, Fig. 1, was taken after for years trying to get the automatic gov-



AFTER LENGTHENING THE ECCENTRIC ROD.

regulate. Card, Fig. 2, was taken after length- e eccentric-rod and putting a dashpot on the . Fig. 3 was taken after putting back into

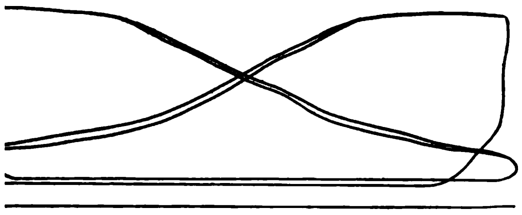


FIG. 3. THE LAST CARD TAKEN.

small steam cylinder on top of the steam chest connected to the valve-rod and had been cut rvice as being useless. F. R. Paine.

What Shall He Do?

f the Engineers' Review:
running a 13 x 17-inch noncondensing, high gine at 285 revolutions per minute, with 100 boiler pressure. The engine load does not ex- horsepower on the average. The question ether it would not be a saving in fuel to use a driven pulley and reduce the speed of the en- 200 revolutions. The engine is driving a house alternator at 900 revolutions per min- tend that although it would lessen the num- ts per minute, the valve travel would be onsequently the cutoff would be longer, and more steam would be used. Others think differently. I would like to hear what your readers think.

A. H. Lane.

Thinks the Commutator is Out of True.

Editor of the Engineers' Review:

In the April number, "Turbino" asks for information to help him out on his dynamo troubles. He states the machine was overloaded. As it is my business to handle dynamos I may possibly be able to help him somewhat. In the first place, I do not believe the dynamo was overloaded. If it was, something besides the commutator and brushes would give way. No amount of load put on a machine will make the brushes bear any harder upon the commutator. It is the tension of the brushes that causes both to wear. If for any reason there is a poor contact between the brushes and the commutator, then the heavier the load, the more spiteful the sparking.

His commutator is undoubtedly out of round. It may feel smooth and look glossy, and yet not be true. I have the same trouble every once in a while. Once, when I could not get a truing machine, the commutator got so hot that one night's run was as much as we could go without fitting brushes. As soon as the commutator was trued up all my trouble disappeared.

If "Turbino" will true up his commutator I feel sure there will be such an improvement in the behavior of his machine, that he will wonder why he did not think of it himself.

When the commutator is not true it requires an excessive tension of the brushes to make a good contact all the time and causes them to wear very rapidly. One of my machines was trued up more than two months ago, during which time I have not touched the brushes, except to see that they were firm in the brush holder. R. C. Havenhill.

Electric Alarms.

Editor of the Engineers' Review:

Having seen a number of electric alarms illustrated in the Review lately, I would like to describe two which I have in use. In my plant we have a machine equipped with a conveyor attached to take away the material, both being run by electric motors. The fuse on the conveyor motor occasionally blew out. The man running the machine, never noticed that the conveyor motor was stopped, until the whole apparatus was choked up for good, necessitating considerable work in getting things running again.

To obviate this, I arranged the alarm which is described here. The magnets *A*, Fig. 1, are from an old electric bell, and are as good as any for the purpose. They are connected up to the motor circuit below the fuses, with a lamp interposed as resistance. This allows just enough current to pass to energize the magnets, which would otherwise burn out. The bell circuit is connected to the armature terminals of the magnet, and is connected below the motor switch. In this circuit a lamp is also used for resistance, which cuts the current down to just enough to ring the bell.

When the fuse is intact and the motor running, the magnet *A* holds the bell circuit open by means of the armature *D*. If one of the fuses blows, the magnet of course, loses its power and the bell circuit is closed by the spring *C*, causing the armature *D* to make contact with *B*, thus ringing the bell.

To stop the ringing of the bell the motor switch is pulled out. When the fuse is replaced the switch is again closed and the bell circuit held open by the magnet until the fuse blows again.

The apparatus is tested at any time by turning off the lamp in the magnet circuit. This apparatus has given entire satisfaction by timely warnings to the operator.

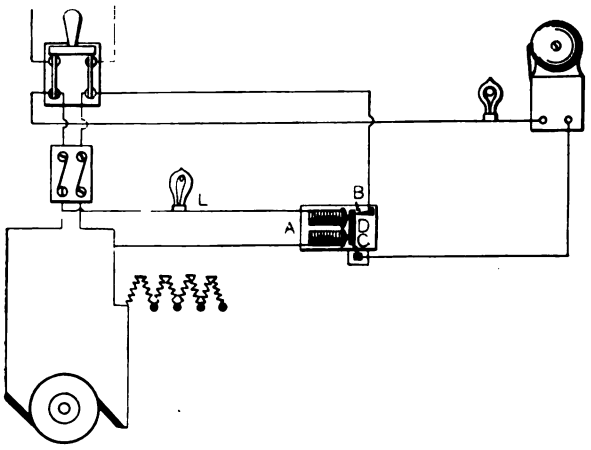


FIG. 1. MOTOR CIRCUIT ALARM.

The boiler is supplied with forced draft delivered by a blower run by an electric motor. When the steam pressure got too high, the fireman was supposed to stop the motor, but in most cases it was not stopped until the safety valve was blowing off. This happened so often that the valve became subject to chronic leakage.

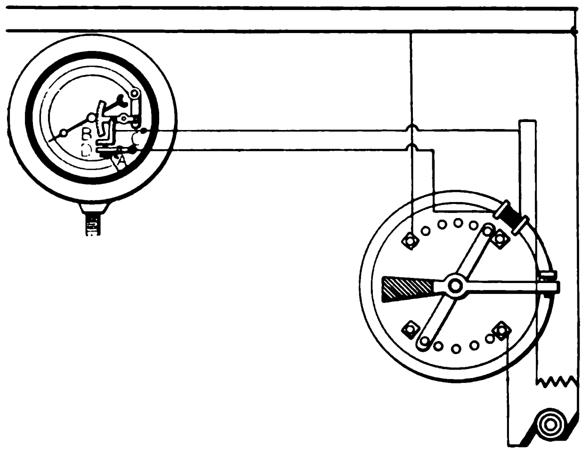


FIG. 2. AUTOMATIC RHEOSTAT FOR BLOWER MOTOR.

To remedy this and save the fireman the trouble of stopping the blower, I connected up the steam gage electrically with the starting rheostat of the blowing motor. By reference to Fig. 2, it will be seen that when the steam pressure reaches a point where the contact arm *B*, in the steam gage makes a contact with the end of the screw *A*, the retaining magnet on the rheostat is short circuited. This releases the which is pulled back to the off position by its and the motor stops. The point of contact is re by means of the screw *A*, and is set so as to contact, about 3 pounds below the blowing ol sure. The contact pieces *B* and *D*, are both c insulated from the parts of the steam gage by of sheet mica. The wire connecting with the is wound into a coil at *C*, so as not to impede the ment of the moving parts. Ever since fitting apparatus, the safety valve has been tight.

I have a deep well pump located about a bloc from the engine room, also driven by an motor. This pump used to give me a good trouble by the belt breaking, coming off, or so else happening to it. The stoppage was oft noticed until the water supply ran short. To this and be able at all times to see from the room if the pump was in operation or not, use of the ground detector lamps on the switc I connected a copper contact piece to one of t line wires at the pump, and arranged another the pump plunger so that the plunger at each grounded the circuit for an instant, thus caus of the ground detector lamps to light up at eac of the pumps.

The circuit is fitted with a safety fuse at th end in case of accidental grounding occurring other side of the circuit. W. Rasm

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Gas Engine Igniters.

Editor of the Engineers' Review:

To those who have had no experience with igniters, a plan of complete wiring from the to the igniter as shown in Fig. 1 will be helpfu one battery is shown to avoid confusion. A switch, *B* is the battery, *C* a spark coil, *D* the

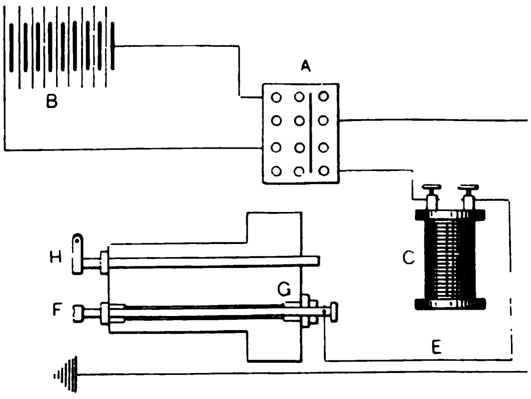


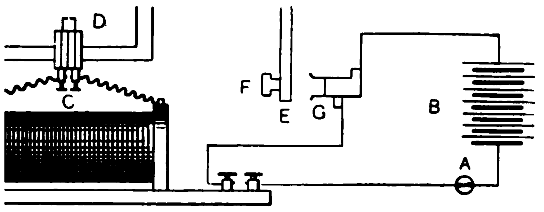
FIG. 1. IGNITER AND CONNECTIONS.

wire and *E* the wire to the stationary electroc niter *F*. This is insulated by means of mica and lava sleeves *G*. *H* is the vibrating elec igniter crank which is operated from a suita on the valve shaft in the case of a four-cycle e direct from the crankshaft in a two-cycle en good ground for *D* is obtained by soldering th a gas supply pipe.

There are a great many different types of on the market, good, bad and indifferent.

uilder claims some special good point for his ar style. The one illustrated in Fig. 1 has ood results. It is simple, and free from freaky ;.

2 shows a plan for wiring jump spark igniters. switch, *B* a battery, *C* an induction coil and *D* electrodes which are insulated from the en-



2. JUMP SPARK IGNITER AND CONNECTIONS.

d each other. *E* is the rotary igniter mechan- n the engine, and *F* is the contact piece which ıe circuit at *G*, at every revolution of *E*.

gniter shown in Fig. 1 is sometimes called the and break" type and differs greatly from the ;park, Fig. 2; the important difference in ake and break" type is that the circuit is and closed inside the cylinder, while the jump rcuit is opened and closed outside the cylinder. ner closes the circuit without sparking, ground- current until the electrode is released which a bright spark to follow across the sparking This type is greatly favored by builders of large :d engines. The jump spark depends on a high- ed current for potential to make a spark jump n air gap, generally about 3-16-inch. The coils . both with and without a vibrator. This type is used on small high speed engines for which it) be well adapted. The contact piece *G*, Fig. 2 case of multi-cylinder engines, a very ingenious ment and is so constructed as to allow timing ng the spark while the engine is in operation. ıe or point of ignition is a matter of some dis- ong engineers, some contending it should be at er when the engine is working with a full load,

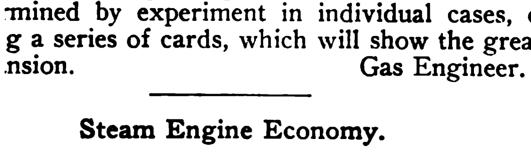


FIG. 3. IGNITION POINT.

et it ahead of the center as shown in Fig. 3, in he arrows indicate the direction of rotation. int varies largely with the quality of gas used, : of load, type of governor, etc., and can best mined by experiment in individual cases, or g a series of cards, which will show the great- nsion.

Gas Engineer.

Steam Engine Economy.

)f the Engineers' Review:

: is a motto which reads "Do your best and apologies." As I am going to apply this motto to the contents of this, my first letter to you, I will at once branch out into the subject which has been a matter of interest to me for some years past. The steam consumption of a steam engine is, as is to be expected, dependent very largely upon the design. We have heard the question of clearance argued and written upon until we have no doubt but that an engine with a small clearance space is more economical than one with large clearance, and while this is probably true, I do not think it so much the clearance space as it is the clearance surface which affects the economy.

It is certain that the larger the amount of cooling surface there is for the steam to come in contact with when it enters the cylinder, the greater will be the condensation, and therefore the more steam required. When the valve is close to the ends of the cylinder, as in Corliss and other types of four-valve engines, the surfaces of the ports and port passages are reduced to only a trifle greater than that of the thickness of the cylinder, which leaves only the cylinder heads and piston with the small additional section of cylinder walls to condense the steam. In this type of engine we expect and get good economy.

In the single valve automatic engine we have a condition that, while simple and compact, loses a little in economy, because of the long steam ports, and from the fact that the cool exhaust steam must pass through the steam passages and the same valve from which the live steam enters. With engines having the single valve we do not get as good steam distribution as when two or four valves are used, with double eccentrics. In the single valve engines the characteristics are that the earlier in the stroke the steam is cutoff, the greater will be the compression and at very early cutoff the compression will become excessive, thus we see that it is not possible to operate the engine with an early cutoff and realize the full benefit of expansion. The clearance surfaces are, however, warmed up by the compression, which is a benefit in its way.

I have never been able to find a rule which would tell how far to carry the expansion in any particular case, although it is generally considered that the best results are obtained in the case of noncondensing engines, when cutting off at about 1-3 stroke. With a simple condensing engine the best results are usually obtained when cutting off at from 1-6 to 1-4 stroke. In compound engines varying degrees of expansion are used, the point of cutoff in the high pressure cylinder usually being adjusted to give from 12 to 20 expansions in both cylinders.

When an engine is overloaded it is useless to expect to operate with any economy, and the same will apply when the engine is too large to do the work, because the point of cutoff will come in one case too late, and in the other too early for the economical use of steam. If the cutoff occurs too early there will be an increased loss from cylinder condensation, and if too late the expansion of the steam will not be carried out as far as it should be. I have found that when an engine is running under these conditions it is better, if possible, to change the steam pressure, or else the speed of the engine, so as to allow the cutoff to occur at a point more nearly at its correct position.

Quoting from a series of tests which I have before me which were made upon Corliss engines of medium size, I find that the amount of condensation and leakage taken together up to the point of cutoff, was 60 per cent of the steam consumed when the cutoff was at 5 per cent of the stroke; 45 per cent when the cutoff was at 10 per cent of the stroke; 35 per cent with the cutoff at 15 per cent of the stroke; 30 per cent with the cutoff at 20 per cent; 20 per cent with the cutoff at 30 per cent and 15 per cent with the cutoff at 40 per cent.

It will be seen from the above that the per cent of loss decreases as the point of cutoff grows later, and the later cutoff may cause as much condensation, and even more, as with an early cutoff, owing to the large quantity of steam used when the cutoff is late in the stroke. It is evident that it is better to operate an engine with too heavy a load than with too light a load, as far as the consumption of steam is concerned.

If an engine is overloaded, the surest way of improving the operation is to add a condenser, the gain of which is from 20 to 25 per cent, when account is taken of the steam consumption of the engine only, but if measured from the coal consumption the gain will be less, because it is not possible to heat the feedwater to so high a temperature by means of exhaust steam when a condenser is used, as when running noncondensing.

It has been demonstrated that the quantity of steam used per horsepower per hour will decrease as the rotated speed of the engine is increased, which is probably because there is less time for the transfer of heat between the cylinder walls and the steam, and for the loss of heat through radiation.

I do not think that because high speed engines are not as economical as slow speed engines, it indicates that it is the effect of the speed, as the losses are due to other causes which would be greater if the engine were operated at a slower speed.

Both theory and practice show that increased economy in the use of steam is by using higher pressure. The reason for this is because there is more heat in high pressure steam available for doing work, in proportion to the amount of heat required to generate the steam, than in the case of low pressure steam, and a smaller percentage of steam is also used in doing useless work.

There is no gain in using extremely high pressure steam in single cylinder engines, because of the loss from condensation, due to the extreme ranges of temperature that would result. For a simple noncondensing engine the steam pressure may be from 100 to 115 pounds, while for simple condensing engines there is little advantage in using steam for more than 80 pounds pressure. The more one looks into the subject of engine economy, it becomes evident that it is a question which requires experience and study to help one arrive at a correct conclusion. Wm. Clifford.

Bill B. Banger on Licensing Firemen.

Editor of the Engineers' Review:

I noticed in the report of the Ohio N. A. S. E. Convention, published in the July number of the Review, that the engineers way up in Cincinnati are getting a little bit scarey, for fear their firemen will jump them out of a job, if the legislature passes a bill giving the firemen a license, which is what the firemen want and I don't blame them. I've got just this to say on the first start off, that if the firemen of Cincinnati are smart enough to get ahead of the engineers, and the engineers so dinged slow as to let them get ah say let 'em go it. Let the heavy hand of conseq fall where it will.

Perhaps the situation in Cincinnati is different other parts of the United States, especially in Ba ville, where I came from. I know they have dif water there from other places, and have more there than can be found in most places, and pe they have different firemen and engineers.

The engineers seem to be getting nervous ov idea that the fireman will get on his ear as soon gets a license, and kick the engineers out of th room if they happen to come into it, and tell then all the engineer has got to do is to attend to his business and the fireman will attend to his. Of c the engineer don't care so much about this part does about the fireman becoming a "source of d to life and property and the public in general.' jinks here's a case where the Carnegie medal f roes should be distributed promiscuously.

I want to stop before I go any further and m a few words pro and con, and several other way try to find out whether or not we are giving th man a chance to hoe his row of taters. I guess 90 per cent of the engineers in civilized countri admit that the engineer's license law has improv condition of engineers in general, whether they w it to or not. Now, if a license law has benefited engineers, what is there under the murky skies o cinnati to prevent a license law from being a ben firemen?

"I CAN COME PRETTY NIGH TELLING WHAT W HAPPEN IF THE FIREMAN GOT FRESH AND TOLD GET OUT OF THE FIREROOM."

When it comes to the engineer losing his c over the boilers, because a fireman secures a li we are going to see things considerably different what they are now, but there is no danger of thi pening. We don't see it in marine service, we see it in the state of Massachusetts, where firem licensed, and we won't see it in Ohio, provided t does pass.

In one little plant where I held down a chair, w three 350-horsepower engines, a couple of air pressors and several other little machines. Th gineers and firemen of this plant all operated chusetts license. The firemen had charge of rs and the engineer had charge of the engine it you can bet the last cent you've got that the did just what the engineer told him to do, and any back talk either. I can come pretty nigh what would happen if the fireman got fresh me to get out of the fire room if I happened der in with a chip on my shoulder because ıg wasn't going to suit me.

foresaid fireman was in charge of the fire room held responsible for the condition of the boil- used, etc., but he was in reality no more in han is the foreman of a room when the super- it has him on the carpet. On the other hand, nen were intelligent men, they had to know about boilers and pumps to pass the examina- were better men than if they had never been to study up on the question.

you fellows that have got your hair standing just keep cool and don't get excited. A thing work in one place ought to work pretty sat- in another, and the licensing of firemen is not ption to the rule. It is possible that I am ıg like James Watt, several years ahead of , even if my whiskers are a little bit scraggly but I know that firemen require as much pro- y law as engineers. The way it is now, in d a dozen other states, a hobo, farmhand, or lse can come along and take a job firing, which ı a practical sense that he will have charge of room when he don't know anything about it, oilers it contains. I know you fellows will say ain't so, and that even if they could get a job uldn't be in charge of the boiler room, but I it is so and for three cents I'll prove it. I'll anyway.

days ago I got an idea that I needed an ex- vacation, so I washed off my chin whiskers, d down my hair as much as I could, put on collar and scraped off some of the grease from s and started for town. I walked around the treets awhile, but they seemed pretty dinged inally I landed in the fire room of a plant where d three 80-horsepower boilers. I tried to be e like to the fireman and sich, and asked him nd of boilers he had and he didn't know. I im what he did for a smoke consumer, but he now. Then I asked him if he used a steam jet, lidn't know, and there wasn't much about the at he did know, but he practically had charge oilers just the same and wasn't a safe man to such a position. That man would never get a rom any inspector or examiner I ever run up

sit right down—I ain't through yet. I know going to say he didn't have charge of the om, but I say he did. Perhaps not in every ut in the main, and it's the same in every plant of. Now, look here, you fellows who are get- d, just stop and think a minute and tell me how ne you spend in your fire room. Put it down ece of paper and send it in to the editor of ew and if it amounts to more than two or three week, except on special occasions, you've got ne run. There's lots of things could happen ne other hours that the boilers are in operation, ver knew a boiler to bust up yet that wasn't under steam. If a man don't know nothin', he don't know nothin', and that settles it, and he wouldn't know how to do anything if an emergency required it.

If firemen were smart, intelligent and understood their business, I don't see how they would be much of a menace to life and property or the public at large, and this is why I say give the firemen a license if they want it. Bill B. Banger.

Much Amused.

Editor of the Engineers' Review:

I was much amused when I read Philip Dase's article about V. V. Privott. I would advise him to keep on taking the Review. Some day he will find something that will just suit him. Then he will be glad that he did not stop taking the paper.

He is right about putting a new tube in at once, for a tube 3½ x 13 would contain about 12 square feet of heating surface, which would be equal to about 1½ horsepower. I believe the best way to do with Babcock and Wilcox boilers, if a tube leaks and you have none on hand, is to make a blind tube by closing up the ends.

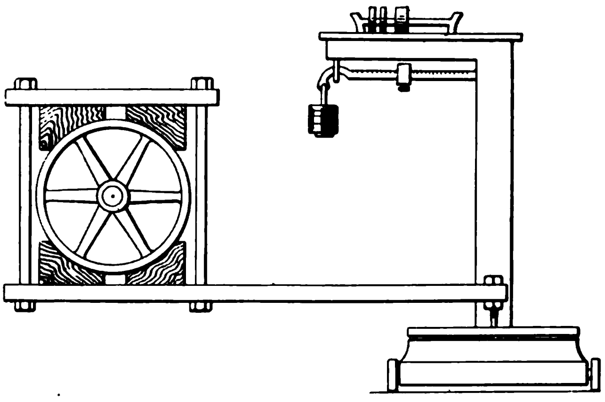
The bulge on the top of F. H. Marsh's mud drum, was caused by a flaw, grease or white or red lead with dirt collected which stuck fast and prevented the water from protecting the plate at that place. The drum should be arched over with brick or asbestos covering.

That is a good kink by H. R. Hatch on page 25 of the June number. I think there ought to be a check valve in next to the ell, in case the steam should blow up the pipe to the lubricator. F. J. Walter.

The Use of the Prony Brake.

Editor of the Engineers' Review:

The letter by M. G. Wilbur in the July issue brings up the matter of prony brakes, but he does not mention the manner in which it is used. Thinking that is might interest some of your readers I am giving a little data in regard to it.



PRONY BRAKE AND SCALE.

Often it is desirable to make a test as to the output of a machine. The use of the prony brake in this connection is shown in the illustration. In the use of the prony brake, a pulley of suitable size is attached to the shaft of the machine to be tested, and on this pulley a friction brake is applied.

In making long runs it is necessary to rig up some means for removing the heat from the brake, although in an efficiency test the run need not be continued longer than to enable the operator to obtain the readings for determining the power input and the power output, for any given load.

The illustration shows that the brake arm is supported by an ordinary scale, which weighs the force at the end of the arm, resulting from the friction of the pulley on the brake. When it is desired to increase the load, the nuts are tightened.

The amount of power which is being absorbed by the brake is the output of the machine, and is calculated as follows: the horizontal distance from the center of the shaft, to the pin resting on the platform of the scale, is the length of the lever, and is designated as L in the formula. N, is the number of revolutions of the pulley per minute, and W is the weight bearing on the scales, measured in pounds. Multiplying the weight by the number of revolutions per minute, by the length of the arm L, and by 2 x 3.1416, and dividing the product by 33,000; the quotient will be the horsepower output.

The formula for the above is: Horsepower output =

$$\frac{2 \times 3.1416 \times L \times N \times W}{33{,}000}$$

One of the correct ways of determining the exact amount of work which a machine or engine is putting out is by the use of the prony brake. I hope that the above will be of assistance to your readers.

F. H. King on page 21 of the July issue asks the question, "What's the matter with Dennis?" In reply I will say that Dennis is all right. He evidently is an honest man as has been said, one who does not intend to take what he is not entitled to. No one will accuse him of being a grafter, which is the polite term for a common thief.

J. Stevens.

Convenient Formulae.

Editor of the Engineers' Review:

I have noted in the Review letters giving formulae, etc., for obtaining results which have been most helpful, and in return I wish to give a few which I think will come in handy for some of your readers.

No. 1. $WP=\frac{TS \times t \times E}{F \times R}$ No. 2. $E=\frac{TS \times t \times E}{R \times WP}$

No. 3. $R=\frac{TS \times t \times E}{F \times WP}$ No. 4. $t=\frac{WP \times R \times F}{TS \times E}$

No. 5. $TS=\frac{WP \times R \times F}{t \times E}$ No. 6. $E^*=\frac{WP \times R \times F}{t \times TS}$

No. 7. $PE=\frac{P-D}{P}$ No. 8. $RE=\frac{a \times n \times SS}{P \times t \times TS}$

No. 9. $P=\frac{a \times n \times SS}{t \times TS}+D$

In the above formulae the values of the letters are as follows:

WP equals safe working pressure; F equals factor of safety; R equals radius of boiler; t equals thickness of plate; TS equals tensile strength of plate; E equals efficiency of joint; PE equals plate efficiency; RE equals rivet efficiency; P equals pitch of rivets; A equals area of one rivet; n equals number of rivets in one pitch; SS equals shearing strength of rivets; D equals diameted of rivet hole; E^* is to be taken as the lowest as found by formula No. 7 or 8.

The average engineer will find these formulae of value to have around handy, which can be d either cutting them out or copying them on a c future use.

M. C. K

The Steam Plant.

Editor of the Engineers' Review:

The May number of the Review has suggest following letter for the Idea Exchange, which out some of the ideas I have, regarding con which govern the operation of steam plants. In to decide upon any point in steam plant practice is under discussion, every detail must be weighe can in any way enter into the operation of the Although this is impossible in the strictest se the word, yet if due consideration is given the r many of the pitfalls into which so many own steam plants have fallen, would be avoided, a cost of operating materially reduced over other of equal size, which have been erected with little thought as to the future.

There are many conditions arising in the room, which will give preference to one type of over another. The nature of the plant decide also the size and shape of the boiler room, th to be done and the amount of available money o ready to put into the business. This last questi the determining effect on a great number of The result is often that of excessive cost late the operation, due to either overloaded boilers gines and in many instances both. Economical tion under such conditions is out of the quest have seen boilers chosen when the setting was fluencing factor in the choice. This is because certain size and type of boiler there was no enough for the ordinary boiler of that size, t with the setting. Therefore, it was necessary t a boiler so designed as to be capable of doi work, and at the same time fit into the space to it.

One point of steam plant practice is ofte looked when new units are to be installed and to have them adapted to the method of transn because this often decides to a great extent, t and type of the engine, and the engine unit upon the capacity of the boiler. No one part steam plant can be altered without influencing i measure other features.

In factory practice the engine is either dire nected to a generator or belted to a line shaft. connected to a generator with motor drive factory, the type of engine is usually that of a r or high speed. When the engine is belt conne a line shaft it is usually of the slow speed ty many instances, however, the space available engine room determines the type of engine. also the location of the plant, whether situated city or country. In the basement of manufa plants located in the city, every foot of s worth dollars for other purposes. It is therefo solutely necessary that every foot of ground f give over to such purposes as will make the vestment for the owner. If it happens to lie direction of the engine room, the engineer i fortunate than most of his brethren.

Another matter which enters into the steam the practice of compounding. There are in

. triple expansion engine will be economical er fitted to do the work than either a single or ıd engine, but to give economical results the ıst be constant at all times. Neither is there ' in operating a compound engine when there ad enough for one cylinder.

though an engineer may have the mechanical o construct or remodel a steam plant, it is no ee that he is fitted to assume charge of the ; force necessary to operate it. The executive o handle men is not given to all, and to this y be attributed the failure of many an engiget results. It has been remarked many times e engineer can obtain certain results with the ; force of so many men, while another can obeater results with a smaller working force. :ret lies in the ability of one to manage the n in such a manner as will bring out the greatınt of work with the least number of workmen hortest possible time.

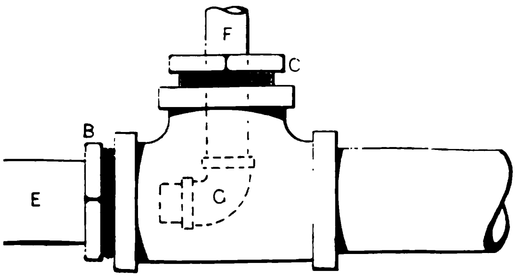
ngineer who can operate his department without is sure to get results. This requires exability of the highest type and it sometimes considerable tact and wisdom to straighten the differences which arise among the engine room forces. With discord and ill feeling the · cannot obtain the best results, because one ll handicap another and the conditions will come disastrous to successful operation.

Gilbert Sacket.

Steam Mufflers.

ɪf the Engineers' Review:

recent issue of the Review, M. O. Taylor deı method he uses for muffling the sound which rom steam when heating water in a tank. I judge his plan a good one and do not present ıod because I think it is any improvement over with the idea that it may be more convenient ıe engineer to make, who does not care to go rouble of wrapping a steam muffler as shown Taylor's illustration.



STEAM MUFFLER.

.r plant we have our water supply arranged a fferent than some plants, as the water is obɪy means of a deep well pump and discharges ınk. From the tank the water is pumped into er.

:ollowing device was arranged for heating the n the tank. It was made up of fittings, as ɔy using a 1½-inch tee. A 1½-inch x 1¼-inch bushing was screwed into the tee, as shown at *B*, and another 1½-inch x ½-inch bushing was screwed in as shown at *C*. Into the 1½-inch end of the tee the suction pipe was screwed, while into the bushing *B* the discharge *E* was screwed. Into the bushing *C* a ½-inch pipe *F* was threaded, the pipe *F* having a long thread to which the elbow *G* was screwed, after which the bushing *C* was screwed into the 1½-inch tee.

In this instance a nipple was threaded into the tee *G*, although it is not necessary. The tee and the nipple point in the direction of the discharge *E*. This device I immersed in the tank to within about 6 inches of the bottom, and by turning the steam on through the pipe *C*, which is supplied with a valve, the water is heated. It will be seen that the steam when turned on causes a circulation through the device, the water entering the suction pipe and discharging through *E*, the discharge pipe, and although the device is not absolutely noiseless, it reduces the noise to a minimum. This device can be used in any kind of plant, where hot water is desired, with equally good results, and is very simple to make.

S. S. F.

Tank Telltales.

Editor of the Engineers' Review:

Although there have been a number of devices described which will register the height of water in tanks, I have ventured to describe the one we have in operation in our plant. This telltale operates by the air pressure in the vessel which is shown at *V*, Fig. 1. It is open at the bottom so as to allow the water pressure to act on the confined air which will be trapped when the tank is filled. Entering in at the bottom of the vessel *V* is a pipe which extends up nearly to the top of the vessel. This pipe is run down to the engine room and attached to a gage which is placed in a convenient place on the wall.

The weight of the water in the tank causes a pressure to be exerted on the air in the vessel *V*, which is transmitted to the air in the pipe leading to the gage. As the pressure increases the gage will of course show a higher pressure, just as if the pressure were steam. By graduating the dial of the gage into fine divisions, the engineer can tell at a glance just where the water is in the tank. Of course a little experimenting will have to be indulged in before the dial of the gage can be graduated to a certainty.

Fig. 2 shows a scheme we have for protecting our whiskers from the wind of the flywheel, as well as a means of safety. It consists of a tin shield which is fitted on over the rim of the flywheel, which in this case is only for the purpose of helping to regulate the speed of the engine. Where a belt is used it is doubtful if the shield would be as feasible as in our case.

The other day a man came into my engine room and wanted to know how he should proceed to lay up a small steam plant for the summer, as it was only used while the weather was cool. The following is the substance of what I told him, which perhaps is just what some one is looking for.

First the man and handhole plates should be removed and the interior of the boiler thoroughly cleaned of mud and scale, if there is any. If the interior surface of the boiler has began to corrode, the places should be painted over with a mixture of red lead and linseed oil. The plates should be left off for a few days in order that air can circulate through the boiler to dry out all moisture. Then several pans containing charcoal should be put in the boiler and the boiler closed up. The charcoal is for the purpose of uniting with the oxygen of the air within the boiler, thus reducing to a minimum the possibility of the plates rusting.

Another method of laying up a boiler is as follows: After thoroughly cleaning it out, fill it up with water. If a little caustic soda is put in the water any carbonic or sulphuric acid, etc., would be neutralized and therefore made harmless. If there are any leaks in the boiler the water will of course find its way to the exterior of the boiler and cause corrosion. This is the one disadvantage in this method.

The furnace should be thoroughly cleaned out of all ashes, soot and dirt, also the combustion chamber, tubes, smoke box, etc. This is important, as ashes, etc., will absorb moisture and if allowed to come in contact with the plate, or in near proximity to it, corrosion will ensue. Provision should be made to either place a cap on the top of the stack, or if the stack is too high to do this, the flue caps of the boiler should be so arranged that the rain cannot trickle down on the inside of the stack and settle on the dry sheet of the boiler. This can only happen when the stack is supported by the boiler front.

In laying up the auxiliaries of the plant, the cylinder heads of the pumps should be removed and the interior of the cylinders wiped out with vaseline, and then the piston of the pump worked back and forth several times, in order to cover the entire surface of the cylinder. If the valves and rods are made of steel, the soft packing should be removed from the stuffing-box, so that the rod will not corrode. Every thing about the pump that is liable to rust should be wiped over with vaseline. The vaseline should always be put on when the parts are cold or it will melt and run to the bottom of the cylinder rods, etc.

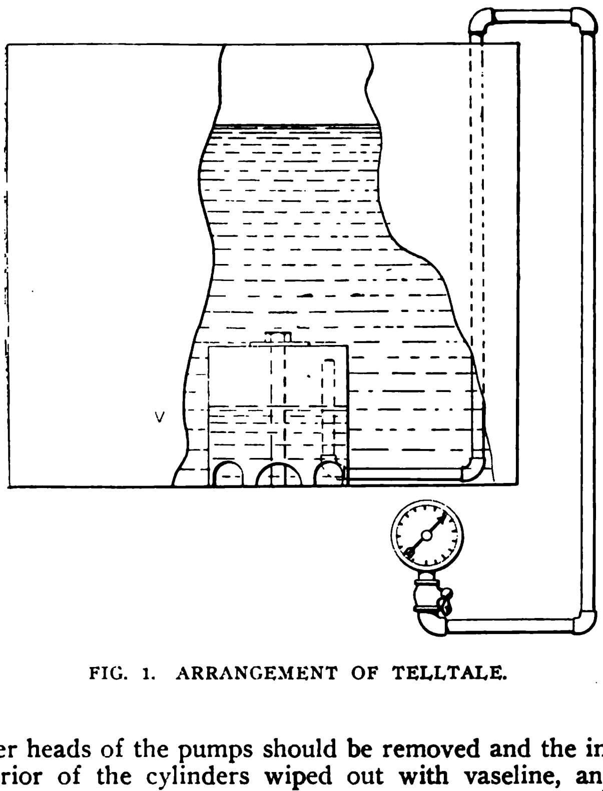


FIG. 1. ARRANGEMENT OF TELLTALE.

In the engine room the same thing should l The oil holes should be plugged up with soft plugs, to prevent dirt from getting into them. tallic packing is used in the stuffingboxes, it r be touched, but if soft packing is used it sh removed to prevent the piston-rod and valv rusting. The cylinder heads should be remo the interior of the cylinder covered with vaseli also applies to the piston-rod and valves, an terior parts that are liable to rust. The engin

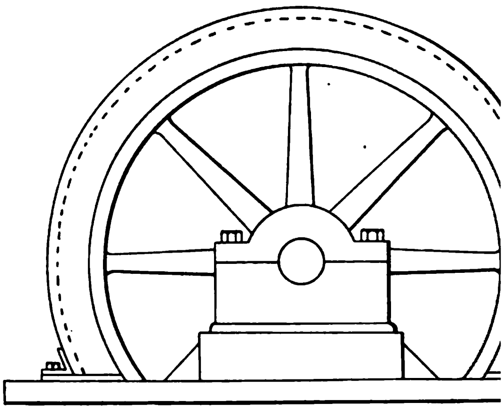


FIG. 2. GUARD ON FLYWHEEL.

be turned over to bring the vaseline in con all rubbing parts. Good cylinder oil can als in the place of vaseline with equally good re perhaps at less expense.

For all bright or polished parts a mixture lead and tallow, equal parts, should be smea them. The tallow is first melted and the tv together and applied with a brush.

Belts and all other apparatus that will be to wet or dampness should be removed to a c and all appliances that are likely to be stolen c in any way should be stored in a safe place.

A. W. F

Indexing.

Editor of the Engineers' Review:

In your March issue Harry Teeman writ teresting article on the card index, but I do he carried the discussion quite far enough. dex itself is a good thing, but how does h papers?

I have been interested in the clipping file since 1896, and waited until 1899 before ac system, in the meantime looking over and all the various files and methods I could fin then, I did not adopt what I believe to be method, because of the expense entailed in cost and the subsequent moving costs.

From the way he writes I should judge Teeman keeps his papers intact in a case, wise, divided perhaps into bunches of six n a year. If this is the case, is he not doing sary work in making his index at all? The ical papers I take all print a complete ind oughly cross indexed, annually or semi-annu can be filed away by years and referred to

ease. The one great trouble is the bulk of
:rs themselves.
: six, some monthly, some semi-monthly and
eekly journals and the accumulation in two
years would surprise one.
ll are not blessed with lifetime positions, and
man has to pay the freight on five or six years
·s, besides the mechanical and light literature
:ollected, and the various cases or files he has
·d during his stay at his last situation, he is
stop and do a little cost accounting before
s his next 500 or 600-mile jump.
one has discarded the publishers' index idea,
; practically unbound volumes of the papers,
best and convenient is the sectional vertical
card index and the clipping, filing, indexing
ss-indexing of such articles as prove of in-

system requires a good deal of attention, la-
time and after a man has "put in" his 10 to
; at work and spent a little time after supper
acquainted with his children before they are
ed, he does well if he reads and absorbs the
of the papers he takes, without sitting up
night writing indexes and filing articles. It
uch a file would prove a valuable asset to his
thoroughly kept, but life is too short for the
us. An outfit like this for filing five or six
or ten years could be purchased for about $50
ınd would prove an ornament to any man's
and moreover, being sectional, could be en-
t will.
lan which I finally adopted is cheap and fairly
ory. I purchased 500 heavy manilla envelopes
inches in size and an alphabetical index on
ıch cards, and made a light box 8½ x 12½ x
s on the inside and stained and varnished it. I
cured some bristol board cut 7 x 11 inches for
; index and was ready for business.
.ding the papers I mark all articles I care to
let the papers accumulate until I have a
ınday, or some equally attractive proposition,
ı I go to work on the file. First I gave a
of envelopes a general index lettered plainly
ıterproof drawing ink at the top left hand
viz.:
es. Stationary Steam—Manufacturing Notes.
es. Stationary Steam—Tests of.
es. Stationary Steam—Defects and Reme-

es. Stationary Steam—Accidents, causes and
etc.
ıuing until I had all I could think of at that
·n as other general index heads came up new
s were lettered and inserted in their proper
All the cross-indexing done was where two
would conflict with each other by being
on opposite sides of the same page. Then the
ne would be written on the index card in the
nvelope and referring to the envelope which
1 the other article. This system is inexpen-
y to handle and saves only the parts one is
to preserve, but in time it will no doubt be-
nbersome and slow.
to understand how "Motor" with his open
ı page 38 can produce a vacuum with that top
n to the atmosphere, unless he has an atmos-
·scape valve, or back pressure valve located in said pipe, in which case his heater would be a closed heater.

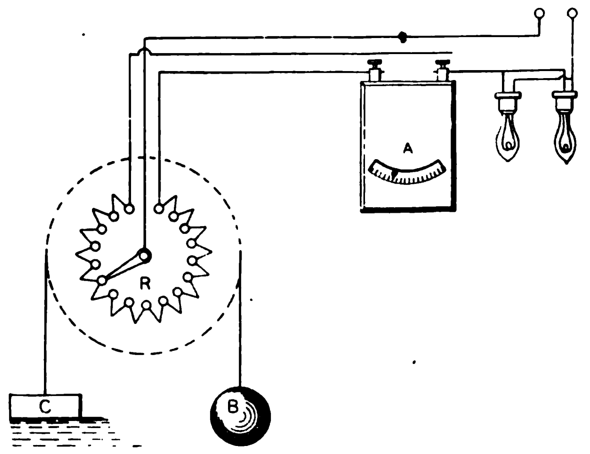
L. L. Arnold.

Water Level Indicator.

Editor of the Engineers' Review:

I had a water tank which was situated in such a manner that it was impossible to run a cord from a float to the engine room. Having on hand an old 3-ampere, 64 point, rheostat, battery and ammeter and having access to a direct current of 110 volts, I connected them up as shown in the illustration.

I made a grooved pulley 2 feet in diameter and attached it to the contact arm of the rheostat *R*. This pulley carried a cord, one end of which was fastened to a float *C* in the tank and the other to a weight *B*. The ammeter *A*, was connected as shown, but the old scale was removed and a new scale drawn corresponding to the height of the water in the tank. Two 16-candle power lamps were placed in the circuit for resistance. This was accurate enough as long as the voltage remained the same. The ammeter could be made with a differential coil and the reading would then be the same, irrespective of the voltage. As the rheostat arm turned from contact to contact, the ammeter showed a different reading, which corresponded with the height of water in the tank.



RHEOSTAT AND AMMETER USED ON A WATER INDICATOR.

F. J. Potter.

Minute Watchmaking Screws.

The fourth jewel screw of almost any of the standard American makes of watches is so small that to the naked eye it looks like a mere speck of metal. It must necessarily be perfect in all respects. When examined under a powerful microscope it is seen that the threads averaged 260 to the inch. It is exactly four one-hundredths of an inch in diameter and over 50,000 could be packed into a lady's thimble with ease. Counting these screws is never attempted, of course, but 100 are weighed on a delicate steelyard and the total number of an output is arrived at by comparing the gross weight with the weight of these. Such tiny screws can only be made in large numbers by machinery, and the operation attending their manufacture is one of the most delicate things in watchmaking.

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CADETS' AVOIDANCE OF ENGINEERING DUTY.

A newspaper editorial saith: "Admiral Clark's great achievement was taking the Oregon from the northern Pacific coast through the waters of two oceans, after the declaration of war and arriving in the Caribbean in time to take a prominent part in the fight and chase off Santiago. His bold and skillful handling of the ship, during a voyage of thousands of miles, in the latter part of which he was in constant danger of encountering a superior hostile force, aroused the country's admiration."

We find in this an important part of the explanation of naval cadets' avoidance of engineering duty. The story of the killing labors of the engineering force of the Oregon which alone made that famous trip possible is an epic in prose. Yet, they get no credit from a country ignorant of the actual responsibilities and proportions of essentiality between engineering and navigating staffs on shipboard. The public, the newspapers in particular, love the spectacular and glorify the buttons and tinsel they imagine standing on the bridge in the limelight. Engineer Milligan, who is the chief hero of the Oregon's record-breaking run, will never be given the credit. History—for historians are only journalists chronicling at longer range and in a cooler atmosphere—will perpetuate the fiction and ingratitude.

FIREMEN STRIKE.

On Sept. 3 the firemen in the plant of the Canton-Akron electric railway system went on a strike. The men had been working 12 hours a day at 12½ cents per hour. They were striking for an eight-hour schedule.

The company attempted to keep the cars going by putting foreigners in the boiler room, but the unskilled labor could not keep up sufficient steam to operate the cars continuously. The service was interrupted each day for several hours.

The company declares that it will not give in a point that will add to the running expenses of the road.

In our last issue we commented on the efforts of firemen to secure a state law requiring examination. We saw no reason why it would not be a good thing. The instance here recorded strengthens our belief that it is needed. The strike was probably futile; it lacks our sympathy. But when employers are stubborn or financially foolish or careless of human life enough to be willing to put utterly ignorant men in charge of boilers, there is need of a law to prevent them from so doing. They are not privileged to imperil life, even in so sacred a cause as making a dividend. And while the strike was unwise and no doubt unsuccessful, it was not without provication. The hours were too long and the pay too small for the work. The men deserved better. It is not just or safe to keep on duty overworked stationary or railway firemen and engineers. There should be limits fixed by statute.

A GREAT EVOLUTION.

The first movement of passengers by steam locomotive occurred Aug. 28, 1830. Seventy-five years is not a long time and there are doubtless men who re-

ber this event, but it is doubtful if this and the
ng generation will witness such progress along
anical lines as has been developed during the past
ears.

e evolution in railroading has been marvelous.
nty-six years ago it was not possible to make
r time in journeying from one point to another
was made 2,000 years ago. Steam locomotives
passenger service were not considered practical
had been used for freight only with meager and
ferent success.

e first locomotive built in the United States and
for passenger service was put in operation by the
imore & Ohio railroad Aug. 28, 1830. This loco-
ve, built by Peter Cooper and named the "Tom
mb," made the distance from Baltimore to Elli-
s Mills in one hour and fifteen minutes; the re-
trip occupying 57 minutes, making an average
d of 12 miles an hour. The entire weight of the
was 4½ tons, while the length of the track was
iles. Today the Baltimore & Ohio railroad is of
00 miles in length. The first locomotive has grown
50,000 and the cost of the first, about $1,000, has
creased that at the present time millions repre-
the cost of the locomotives operated by railroads.
raveling at the rate of 60 miles an hour is of every
occurrence, while at times bursts of speed are
e at a rate of 90 miles, or more, and this with our
lar passenger trains. From the primitive passen-
coach of six seats, the traveler of today is sur-
ded by luxury and comfort and can travel from
ocean to the other; from the frigid north to the
ical south in a few hours. Time and distance
in a measure been annihilated. Such is progress.

ABOUT GRAFT.

. A. E. has in this number a letter on graft among
neers. The writer gives no hint of his special
ss to pass judgment on this subject. He must,
efore, be judged by the inherent evidence of such
rstanding, which indicates that he is a "layman"
has been listening to the wails of unsuccessful or
perienced dealers. Such deliverance as he quotes
crack a smile on the most saturnine countenance.
he writer remembers having heard this note in
mournful plaint of the ravens of the engineers'
ly trade fifteen years ago. It was touched ten
s then to once now. In fact, it is getting very
h out of tune. It is hardly recognizable when it
ates the air.

ar be it from us to protest that never was there
ng born of experience that found true expression
hat chord. Undoubtedly there was some cause,
if we judge the cause by the number of ravens
the tears in their voices, it has been steadily
inishing and is now more nearly extinct than
before.

or engineers are only men, with the same desires
sensations, the same requirements, ambitions and
tations, the same kind of wives and chilren, as
r men. Who is this superintendent of heat trans-
ation or knight of the monkey wrench, or what-
he is or considers himself, that his virtues should
f stronger fibre than those of his fellows in other
ngs who went with him to the same school, poached in the same orchards, got licked with the same rod, and were turned out on the same tough world to shift for themselves? His schoolmates became plumbers, walking delegates, bankers, senators. None proved strong enough to preserve the eighth commandment inviolate. Why should more be expected of him? Are his opportunities more or less than the average man's? What are his needs? What his compensation?

We believe that men in no other line of work are placed in a position to try their integrity so severely. The great majority are underpaid and overworked. The machine hand in the shop often gets as much as the engineer for two-thirds the hours put in. The hazard of the job is not approached in any other calling in which so many are engaged. And if any other modern Adam has had more luscious fruit within easier reach or a more seductive voice to urge him to indulgence, we have not heard of him. Here is the overworked and underpaid engineer spending ten times his wages for his employer, with little or no check on him in many ways. True the employer uses the hammer on the coal dealer, the packing man, the oil refiner, as he does on the engineer, but he knows nothing of these things. Though he arrogate to himself all ordering and reduce the engineer to a mere manual laborer, still he is not his own master. The engineer is generally the only man on the premises who has the least knowledge of the plant's requirements.

In the end the engineer can, by representations to the employer, control the goods bought, for the most part. Thus, his opportunities hang like berries along a cow path in August. The chances to square accounts with his churl of an employer need but the grasping.

But what are the facts? Grafting, which seems to be on the increase generally, is growing less among engineers. It is the exception. It is true that much money is spent by dealers in cultivating engineers and some of it may punctuate the demarcation line, dividing legitimacy from illegitmacy.

But we have reason to believe that when the 99 engineers recommend or order or report, they favor the goods they honestly think will prove the best, all things considered. Never was it so difficult to buy these men. They are peculiarly straightforward as a class.

It is very dishonorable for an engineer to accept a bribe. It does not pay. No matter what the provocation of hard, heartless dealing, no matter how easy to get or how impossible of detection, the man who grafts loses a part of his own soul—his self-respect. We do not condone this fault in engineers, because it is rare and diminishing.

RUN ENGINE WITHOUT LICENSE.

As the result of a recent trip of inspection through Cleveland factory districts, Joseph Howle, district examiner of stationary engines, has begun a crusade against engineers who are without licenses. Howle found several violators of the stationary engine law which requires every engineer of a stationary engine to be licensed by the government inspector, and notice was served on them to comply with the law within 30 days or be subject to arrest.

QUESTIONS
·OF THE HOUR·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.

The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

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(446) T. W. S., Noringer, Mo. Q.—"How many feet will the best make of steam jet discharge water in height with 80 pounds steam pressure?" A.—Conditions vary the distance. At best the height will not be great. You do not give the size of the suction or discharge pipe or the size of the steam inlet. A jet having a 1¼-inch suction, a 1-inch discharge with a steam opening of 5-16-inch will discharge about 20 gallons of water per minute. The height of the water would be about 3 feet.

(447) F. P. K., Saxonville, Mass. Q.—"Will you kindly tell me if the pressure carried by a steam boiler has anything to do with its horsepower? Is not 15 square feet of heating surface allowed per horsepower?" A.—The pressure of a steam boiler is not figured in determining its horsepower. The heating surface divided by 15 is not always a sure way of determining the horsepower. In fact, it is rather a crude way, as from 8 to 15 square feet of heating surface are allowed per horsepower (so called), depending upon the type of engine. Plain cylindrical boilers have a ratio of heating surface to each horsepower, of from 6 to 10 square feet, the flue boiler of from 8 to 12, the multitubular boiler of from 14 to 16, the vertical boiler from 15 to 20, the water tube boiler from 10 to 12, and the locomotive boiler from 1 to 2.

The proper way in which to determine the horsepower of a boiler is to figure the pounds of water it will evaporate into steam.

The American Society of Mechanical Engineers have decided that the standard boiler horsepower shall be equal to 33,330 B. T. U.

In order to evaporate a pound of water at 212 degrees into steam at atmospheric pressure or 212 degrees, it will require 966 B. T. U. Therefore the horsepower is equal to the evaporation of 33,330 divided by 966 which equals 34½ pounds of water from and at 212 degrees.

(448) F. V. S., Orion, Ill. Q.—"Would it be advisable to use the regular boiler feed pump to force a strong solution of soda ash or kerosene into a boiler, say 3 to 5 gallons soda ash, or 1 to 3 gallons of kerosene when about ready to shut down in the evening, the boiler to be cleaned the next day?" A.—There is no objection to using a boiler feed in pumping soda-ash or kerosene into a boiler. This method is one that is pursued by engineers everywhere who favor the use of either. Care should be taken in using a strong solution of soda-ash while the boiler and engine are in operation as it will cause foaming and water is likely to be carried over into the cylinder. With kerosene, however, it makes little difference when it is fed in. A good way is to feed it through a device drop by drop rather than to put in a large quantity at one time. Good results might, however, be obtained by pumping in a gallon or so after all valves have been closed leading from the boiler, and allowing the water to slowly escape when ready to clean. This permits the kerosene to cover all the interior surfaces of the boiler below the water line. Another good way to use kerosene is, after washing out the boiler, put in two or three gallons and allow the water to enter very slowly while filling. In this way the oil remains on top of the water and thoroughly covers every portion of the interior as the water rises. Care should be exercised in opening up a boiler in which kerosene has been used, as the gas is liable to explode if a light is brought near. The boiler should be ventilated before entering to clean.

(449) Same. Q.—"What is meant by alternations and cycles of an alternating current dynamo. For instance I have an alternating dynamo, 2,000 volts single-phase with 12 poles running at 1,400 revolutions per minute. What are the alternations and cycles of this machine?" A.—An alternating current is one which alternates from one direction to the opposite direction in each revolution of an armature coil. Each reversal of the current which is an increase in the current from zero to its maximum and the decrease to zero again is called an alternation. In the case of a coil of wire rotating in a magnetic field, the current in the loop goes through each alternation in each half revolution and through two alternations in a complete revolution and the process is repeated in each revolution so that each number of repetitions of a pair of opposite alternations is called a cycle. A cycle is completed during the time that a coil passes under two adjacent poles. The frequences equal the number of revolutions multiplied by the number of pairs of holes. For instance a 12-pole machine is running 1,400 revolutions per minute. For each revolution there would be 12 alternations to make a cycle and as it takes two alternations to make a cycle there would be 6 cycles to each revolution, therefore there would be 1,400 alternations for each coil of the armature and as there are 12 coils, there would be 16,800 alternations per minute or 280 per second. As it takes 2 alternations to make a cycle there would therefore be 280 divided by 2 or 140 cycles per second.

(450) J. W. M., San Francisco, Cal. Q.—"How hot will the exhaust steam from the 16 x 32-inch Corliss engine, doing 65 indicated horsepower heat 7,000 gallons of water per hour?" A.—With tight valves a Corliss engine will require, with a boiler pressure of from 75 to 90 pounds about 25 pounds of steam per horsepower, cutting off at from 1-4 to 1-5 stroke. The actual steam consumption of an engine can only be obtained by condensing the steam and weighing it separately from the condensing water. The walls of the cylinder cools the steam, and the heat taken from it in doing work causes the temperature to fall. The exhaust steam with which the feedwater is to be heated therefore, escapes at a considerably lower temperature and pressure than at which it enters the cylinder. As the temperature decreases with a decrease in pressure, the temperature of the exhaust steam can be found the same as the temperature of the live steam, *i. e.*, from the steam tables. Assuming that the engine has a back pressure of 3 pounds, the temperature at that pressure would be 221.53 and the total latent heat would be 959.35. When steam and water are to mix the final temperature of the condensed steam and water is found by adding together the latent heat and the temperature

steam and multiplying the sum by the weight of
am. To this product add the product of the
and temperature of the water, and divide the
the sum of the weights of the steam and water.
otient will be the weight of the water. The
a is:

$$T = \frac{W\ (L + t') + w\,t}{W + w}$$

engine is developing 65 horsepower the amount
n discharging to heat the water will be 65 ×3 =
unds. Then W = 195 pounds of steam; L =
B. T. U., the latent heat at 3 pounds pressure;
1.53 temperature of the steam; w = weight of
7,000 pounds, and t = 60, the temperature of
ter. Using the above figures we have:

$$\frac{95 \times (959.35 + 221.53) + 7{,}000 \times 60}{195 + 7{,}000} =$$

.4 degrees.

) Same. Q.—"How many gallons of water
e same amount of steam heat to 160 degrees?"
sing the same figures as in the preceding ques-
find that the difference in the temperature of
ter is 160 — 60 = 100, the number of degrees
ter must be raised. Steam at 3 pounds pressure
s 959.35 B. T. U., and as there are 195 pounds
m at that pressure the total number of B. T. U.
959.35 × 195 = 187,073.25. As one B. T. U.
ise one pound of water one degree, to find the
umber of pounds of water which will be heated
degrees, we have 187,073.25 ÷ 100 = 1,870.7
. There are 8.33 pounds of water in a U. S.
therefore 1,870.7 ÷ 8.33 = 225.7 gallons of
hich would be heated to 160 degrees.

PALMETTO TWIST PACKING.

etto twist packing is intended for the packing
es, spindles, small rods, etc., formerly effected
ans of cotton wick or asbestos, doped with
and plumbago. As its name implies, it is a
r yarn of fibrous substance, consisting of sev-
parate and easily separable strands, impreg-
with a durable lubricant of high fire test and
complete packing in itself. For a small valve
or rod, a single strand makes a complete pack-
r larger sizes several strands can be used.

claimed by the manufacturers that the material
ch the packing is composed, ensures retention of
nce to heat and pressure and a tight joint with
st compression, all features that peculiarly fit
the purpose of which it is employed. It is
om the tendency to pack hard, score rods, burn,
r blow, as displayed by non-elastic packings,
the convenient form in which it is supplied, in
spools of 40 yards, and the fact that it keeps in-
ly and is always ready for use, recommend it.
anufacturers, Greene, Tweed & Co., 17 Murray
New York, will send a sample spool free.

ACME OIL FILTER.

principle of lubrication consists in the interposi-
etween two surfaces in frictional contact, of
or cushion of a fluid character, that will adhere
surfaces and smooth over their respective in-
ies and which, at the same time, possesses suffi-
ohesiveness, to prevent it being squeezed from
n two bodies in close contact. The oils commonly used for this purpose, consist of an infinite number of minute globular molecules, having sufficient cohesion to keep them together, but not enough to prevent them rolling over one another, thus forming as it were a roller bearing between the two surfaces. As long as the oil used—if it has been properly selected for the work it is to do—is kept free from dirt and grit, it remains a good lubricant, it can be used repeatedly if cleansed from foreign particles. This can be satisfactorily accomplished by means of the Acme oil filter, manufactured by the Walter L. Flower Filter Co., 1011 Chemical building, St. Louis, Mo. The oil as it is collected from bearings, etc., after doing its work, is passed through the filter, its pristine utility for lubricating purposes being thus continuously renewed. It is said that an Acme oil filter will thus save in a year, four times its first cost in the oil it will return to service. Its effect on oil bills is admittedly remarkable.

PRESTON'S FLINT HIDE BELTING.

The Flint hide belting is composed of a strip of hard dry rawhide, dried in its natural state with all the glutinous and life properties left in, which gives it greater strength and lasting qualities.

In order to give a friction surface the rawhide is placed between two plys of canvas, which is coated with a solution of waterproof and gives it adhesive qualities which are said to be excelled by no other belt.

It is claimed that the annoying features of stretching, separating of the laps, opening up of the seams, stretching on one side and running crooked, is eliminated, which is a saving in expense and labor as it is not necessary to take up the belt continually. It is also claimed by the manufacturers that their practically non-stretchable belt has greater tensile strength, longer life, and will develop more uniform horsepower than any other belt. The belt is made in light, medium and heavy weights, and in every width.

The belting is manufactured by the Chicago Raw Hide Manufacturing Co., 71 Ohio street, Chicago, Ill. This company were the first to make rawhide gears and pinions. They also make rawhide hydraulic packing which is anti-friction and is said to be the most durable on the market.

"CLASS W" PRESSURE REGULATOR.

The regulation of steam, air and water pressure enters to an increasing extent into modern engineering and industrial operations, with the growing tendency in favor of central power generating plants. To obtain the full benefit of this centralization of power, means for reducing the pressure of air and steam, from the high pressure most economical for distribution, to the lower, practicable working pressures, must be employed. The pressure regulators manufactured by the Foster Engineering Co., Newark, N. J., have proved exceptionally successful for this purpose. Their "Class W" pressure regulator, is a standard device, in which the valve governing the pressure is controlled and operated by the movement of a diaphragm, opposed to the action of springs, whose tension is adjusted according to the delivery pressure to be maintained. This pressure is entirely independent of pressure in the supply pipe. The regulator is delicately accurate, positive and reliable and is in successful use in many manufacturing establishments, mines and other places, where power, steam or compressed air, distributed from a central source, requires regulation and reduction.

The Foster Engineering Co., are makers of a number of practical pressure regulating contrivances. Their catalog, which may be had for the asking, describes them.

EUREKA PACKING.

Of all the annoyances with which an engineer is confronted, those originating in his packing are probably most common. They have a far reaching effect on engine efficiency and economy; a leaky stuffingbox, due to loose or faulty packing, means not only waste of fuel and power, but it robs the most carefully taken indicator card of its value; hard packing means a scored and worn rod and more leaks. These and other packing troubles usually call for treatement after hours. Poor packing is the fundamental cause of most of these troubles, for which there is no excuse, with good packing costing so little and available in such convenient form.

"Eureka" is the trade name of a packing claimed to be particularly free from these defects. It is made with a rectangular core of pure rubber, well covered on all sides, with closely braided long-fibre flax, impregnated with lubricant of high fire test. The elasticity of the rubber makes the packing readily conformable under light compression, to the shape of the stuffingbox in which it is used, it also adapts itself to the form and movement of rods that are scored and out of true. The rubber is protected from contact with the rod, frictional wear and direct effects of steam heat, by the lubricated flax covering, which stands the hardest wear and reduces friction to a minimum. Eureka packing is made for every use, is easily cut into rings, saves the engineer's time and, by assuring him a well packed stuffingbox, enables him to avoid packing troubles, Jas. L. Robertson & Sons, 402 Fulton street, New York, are the manufacturers of Eureka packing and will send catalog on request.

ADVERTISING ENGINEERS.

In order to make a new machine a commercial success, especially if in design and operation it differs from others built for the same purpose, it is necessary to educate possible users so that they will appreciate its advantages. This is being realized more and more and as a result the amount of money spent for educational advertising mounts up into the millions yearly.

Some engineering and manufacturing concerns have established advertising departments and have placed them in charge of men of high ability. This plan, however, is more expensive than most businesses justify and many firms attempt to handle the work through already overburdened executive officers or else turn it over to clerks.

To meet these conditions, Mr. Halbert P. Gillette, M. Am. Soc. C. E., Am. Inst. M. E., formerly associate editor of Engineering News, and Mr. Geo. H. Gibson, A. M. Am. Inst. E. E., J. M. A.m. Soc. M. E., formerly manager of publicity for the International Steam Pump Co., manager of the advertising department of the B. F. Sturtevant Co., and editor of the Westinghouse Companies' publishing department, have formed a partnership as " advertising engineers," under the name of Geo. H. Gibson Co., with of
the Park Row building, New York City. They
take to conduct a firm's advertising in the same
as would a department in the firm's own offic
are not advertising agents in the usual sense
term, as they receive no commissions, renderin
service and leaving the actual purchasing of sp
printed matter in the client's hands.

WIRE ROPE LUBRICATION.

Elevator and other cables used for hoisting p
are subject to both internal and external wea
less these cables are kept well lubricated they w
deteriorate rapidly.

Dixon's Handy graphite rope dressing
the ideal wire rope lubricant in such a form as
it thoroughly acceptable to practical men wh
used it. The package is of about the size an
of an ordinary book and contains nearly 3 po
graphite lubricant. It is easily applied by hold
open edge of the package against the cable w
motion.

APPLYING DRESSING TO A ROPE.

There is no trouble and no danger to the w
no waste or dripping off of lubricant. The
and efficiency of Dixon's handy graphite rope
in prolonging the life of wire rope and saving
pense of frequent renewals of worn cables, sho
mend it to the careful attention of every firm
ing hoists or elevators. It is manufactured
Joseph Dixon Crucible Co., Jersey City, N. J.

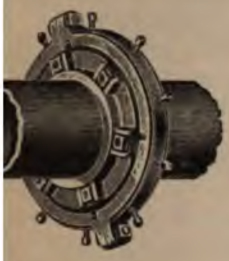
THE MODEL FLANGE CLAMP.

It often happens that a leak occurs betw
flanges at the most inopportune time and wh
impossible to shut down and renew the packing
are also many times when it is not practicable
a joint as it may necessitate a large expense
clamp can be attached in a few minutes with t
sure on the pipe and will successfully repair
until it is convenient or advisable to renew oth
ings on the line when the clamp can be remo
saved for future emergency.

By referring to the illustrations, Figs. 1 an
mechanism used will be thoroughly understoo
clamp consists of an outer ring made in two
in which the compression screws are placed; a
or compression ring made in four sections,

ach section to correspond with a slot in the
ng, thus assuring no displacement while at-
The gasket shown in Fig. 2, which is to be
round the flange over the leak, is also fur-

is means it is possible to get any desired pres-
d it will be equal at every point. If for any



AMP ON FLANGE.

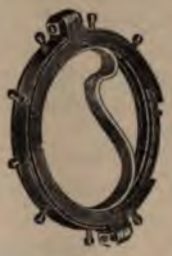
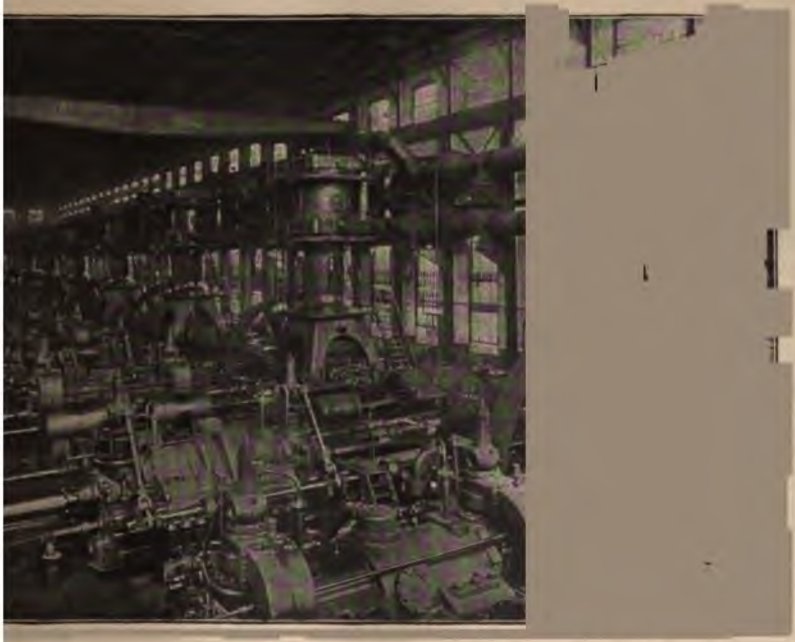


FIG. 2. SECTION OF CLAMP.

leak appears around the bolts holding the
together, it is an easy matter to pack around
with a little hemp soaked in white or red lead,
use of a common iron washer. The model
lamp is made from first class material, painted
ct it from rust, and guaranteed to give satis-
It is made by Jas. McCrea & Co., 70 West
ton street, Chicago.

ECONOMICAL LUBRICATION.

st of all items on the supply account of any
lant is the oil bill. It is usually exceeded only
osts of fuel and wages—even the repair bills
ll-kept modern plant aggregating ordinarily
n the costs for lubrication of bearings, cyl-
nd other rubbing surfaces. Economy of lubricating oils is consequently a matter of no mean importance, and becomes of special moment when savings so great as 50 per cent are possible.



LACKAWANNA STEEL PLANT EQUIPPED WITH THE WHITE STAR OILING SYSTEM.

The attention being given nowadays to this feature of power plant economy is well shown by the careful arrangement of lubrication details in some of our modern installations of largest size. For instance, the Lackawanna Steel Co., of Buffalo, N. Y., are equipping their engine plants for utmost economy of oil usage and handling.

At these mills, the largest steel works in the world, there are installed 48,000 horsepower of engines, of which five are Allis-Chalmers vertical cross compound steam engines giving 16,000 horsepower for driving roll trains, etc. There are two blowing engine houses, each with eight units driven by 2,000-horsepower Koerting gas engines built by the De Lavergne Machine Co., New York. The illustration shows the interior of one of these plants. The complete power installation of 48,000 horsepower is now being equipped with the "White Star" continuous oiling system, manufactured by the Pittsburg Gage & Supply Co., of Pittsburg, Pa.

By this system the oil is distributed continuously to all bearings, keeping them constantly supplied with just the right amount of oil to insure best results. All drips and used oil is drained away to the "White Star" filter, which constitutes one feature of the system. Passing into the filter it is there cleaned of all impurities, and is then pumped to a storage tank from whence the oil is returned to the circuit. Loss of oil is avoided entirely, the only means of escape from the system being by actual wearing out in the bearings. This, of course, means the greatest possible economy.

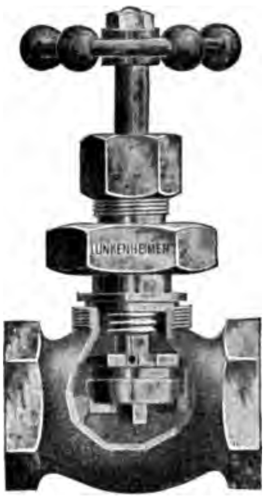
Consideration of usual conditions will readily show the experienced power user how easily this system may effect a great saving of oil, eliminating waste losses and insuring actual use of every drop. About two years ago the power plant of the Union Steel Co., at Donora, Pa., was equipped with the "White Star" system. Previous to this installation, a 38 and 75 by 60-inch twin tandem compound condensing engine, Porter-Allen type, required an average of 1,050 gallons of engine oil per month. This has been cut now to an average of 503 gallons under similar conditions—a saving of more than 52 per cent. In this same plant on two 30 and 60 by 48-inch engines, the oil consumption was reduced from 400 gallons to 105 per month, operating full. As a further item of saving directly credited to the "White Star" system, the services of three oilers required under the old regime were dispensed with from the start. The wages account, therefore, also shares in the general economy.

Bearing upon this general subject of modern engine lubrication, the Pittsburg Gage & Supply Co., Pittsburg, Pa., have some interesting literature which they forward to anyone interested.

IMPROVED REGRINDING VALVES.

The illustration shows a sectional view of the Lunkenheimer improved regrinding valve. While the changes are not all radical, the weight has been increased as an additional precaution against rough handling while attaching, etc. The valves are also altered in shape which increases the area through the valve, permitting an unobstructed passage, which is more than equal to the connecting pipe. The pipe threads have been made considerably longer, thereby overcoming the danger of stripping them which so often happens where unskilled workmen are employed. All valves now have lock-nuts on the handwheel which facilitates the taking apart and assembling of the valve for repairs.

Referring to the sectional view it will be noticed that the hub which carries the operating stem is secured to the body by a uniform connection, which in turn screws over the shell of the valve body, thereby preventing the hub and the body from corroding together, as the threads which hold the union ring to the body are always protected from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie, or binder in screwing over the body and tends to make the valve more rigid. The disk is loosely fitted to the stem by means of a lock-nut and will, therefore, readily adjust itself to the seat.



LUNKENHEIMER REGRINDING VALVE.

To regrind the valve the bonnet is unscrewed and the trimmings removed from the body. A wire or nail is placed through the lock-nut and stem, a little powdered sand, or glass and soap, or oil is placed in the disk, and the trimmings are again placed in the valve and reground. The bonnet has a small rim or projection on the bottom of it which acts as a guide on the inside of the valve neck while regrinding. The seats in the valve bodies are very small when new which permits of considerable regrinding, which is an important factor.

The valve can be packed under pressure, even
or closed. It should be open as wide as possible
packing with steam flowing through it so th
shoulder at the top of the steam will form a se
neath the stuffingbox.

The valve is made of the highest grade of t
composition and is thoroughly tested and inspect
fore sending out from the factory. The stuffing
are packed and ready for immediate use. wh
ceived. The medium pattern valves are guar
to stand a working pressure of 100 pounds per
inch and the extra heavy pattern up to 300 pour
square inch.

This valve is manufactured by the Lunken
Co., Cincinnati, Ohio.

NEW BOOKS AND CATALOGS.

LARKIN'S METALLIC PACKING is described in
let issued by the manufacturers, the Pennsylvania E
& Railway Supply Co., of Pittsburg, Pa.

A BOOKLET giving a very satisfactory descriptio
Simonds simple and compound vacuum systems of stea
ing was handed us by Frank A. Simonds, Grand Rapid

DDEDS' METALLIC PACKING is illustrated in
furnished by the Pioneer Brass Works, 430 S. Penn
street, Indianapolis, Ind.

"BOILER HEALTH" is the title of a booklet whi
tended to describe the Barnum feedwater heater and
which is manufactured by J. N. Barnum & Co., Cleve

THE ERIE STAMPING & MFG. CO., Erie, Pa.
facturers of oil cups, grease cups, oil reservoirs, nut
etc., have sent us their catalog.

THE MONTHLY RECORD of scientific literatu
published and kept in stock by the D. VanNostrand
Murray and 27 Warren streets, New York, has been

THE SATURATING AIR SURFACE COND
for exhaust steam, which is manufactured and inst
the Atmospheric Condensation Co. of Kansas City,
described in a booklet which has been sent us.

A FOLDER describing the Dunham steam trap,
said to be the smallest trap with the largest capacit
trap in the world, has been received. This trap is
tured by the C. A. Dunham Co., Marshalltown, Ia.

LEFFEL ENGINES AND BOILERS, which ar
factured in sizes of from 6 to 40 horsepower, are
in Booklet No. 55 which is being distributed by the
fel & Co., Springfield, O.

THE ADVANTAGES of the Reliance safety w
umn are set forth in a circular that is being sent ou
Reliance Gauge Column Co., 86 E. Prospect street
land, O.

THE WERDER graphite and oil pump for cylind
cation is briefly described in a small booklet issue
manufacturers, the Milwaukee Metal Working C
waukee, Wis.

THE MILLER GAS ENGINE, which is manufac
the Miller Improved Gas Engine Co., Springfield,
very completely described and illustrated in a catalo
us. This engine is built in sizes from 50 to 250 horse

THE FISHER steam pump governor which is
tured by the Fisher Governor Co., 1202 Main stre
Marshalltown, Ia., has many advantages which are
in a folder recently received.

A NEW RECEIVER and oil separator is being p
the market by Walter J. McKnight, 70 Riley street,
N. Y., and is described in a circular that has com
attention.

THE DE LAVAL STEAM TURBINE CO., Tre
J., have sent us a copy of Bulletin No. 10 which
the works and product of this company and contains
of the inventor of the turbine, Dr. DeLaval.

MILWAUKEE SEPARATORS, both horizontal
tical types, are described in a booklet issued by the
turers,the Steam Appliance Co., 250 Oregon stre
waukee, Wis. A copy of this booklet will be sent to
mention the Engineers' Review.

THE LATEST CATALOG and price list issued
Crandall Packing Co., Palmyra, N. Y., has been
This company manufacture different types of improv

.nd hydraulic packing and will be glad to send their
:o any interested parties.

)OKSON improved steam trap, which is now manu-
nd sold by the D. T. Williams Valve Co., Cincin-
, is described in a twelve- page booklet. All the
arts are illustrated and all description that is neces-
en.

JT of a Ball side crank, cross compound engine,
nected to an alternator has been received. This
ı heavy paper suitable for framing and one can be
rom the Ball Engine Co., Erie, Pa., by mention-
ublication.

IFE HYDRAULIC ENGINE is the subject of a
ued by the Power Specialty Co., 126 Liberty street,
:. It is claimed that this engine will pump water
gh, can use a fall from 18 inches to 50 feet and will
eet high for every foot of fall.

3LUE BOOK OF AIR COMPRESSORS," which
ıy the Ingersoll-Sergeant Drill Co., New York, is a
some piece of printing. While it is not large, a
factory description of the different types of com-
ıade by this company is given.

E CATALOG No. 3 issued by the I. & E. Green-
Cincinnati, O., has been received. This company
re several different types of engines for either
direct connection. Also either cross compound or
ımpound.

KNIFE HANDLE screw wrench is described and
in a folder recently received. It is claimed that
vrench is the original screw wrench. It is made by
Vrench Co., Worcester, Mass. This is not the only
ench they make, however, and a description of their
ine will be furnished to all who inquire.

YOU AN OLD FOGY?" is the title of a folder
the General Specialty Co., 73 Carroll street, Buffalo,
:sides a number of letters recommending this com-
er tube cleaners and a list of users, a brief descrip-
o given of the Torpedo fire tube boiler cleaner and
ı water tube boiler cleaner.

Y HANDSOME CATALOG is No. 180, describ-
:haust fans manufactured by the American Blower
ıit, Mich. In the large list of apparatus manufac-
his company are included all kinds of blowers, fans,
apparatus, heating and ventilating machinery, dust
, steam traps, steam engines, etc.

Y HANDSOME BOOKLET has been issued by
Vebster & Co., Camden, N. J., which describes the
ystem of low pressure steam circulation for heat-
ıses. Included in this book are photographs of
ıe largest buildings in the country in which this sys-
een installed.

MERICAN PULLEY CO., 29th and Bristol streets,
ıia, Pa., have issued a book which is entitled "The
History and the Wheels of Industry." Consider-
esting information and many handsome cuts are
in this book which will be sent to any engineer upon
ı.

LLUSTRATED CATALOG describing Weinman
nps has been sent us by the Weinman Machine
ılumbus, O. Besides steam pumps this company also
re air compressors, power pumps, deep well pump-
:s, combined pump and boiler outfits, combined gas
ıd pumps, etc.

VM. POWELL CO., Cincinnati, Ohio, have issued
ive booklet describing and illustrating Powell's re-
Vhite Star disk valves. Every detail is taken up
. The White Star check valve is also described.
ıeveral different types are shown in this booklet.
ıfacturers will be glad to furnish further informa-
y one desiring it.

CADMAN MFG. CO., Pittsburg, Pa., have sent us
describing their Acorn brand of aluminum and bab-
. This metal, which is said to be of higher price
of the other kinds on the market is also claimed to
rior quality. This company also manufacture blow-
, gage cocks, coke oven valves, feedwater heaters
e and aluminum castings.

AL DIFFERENT CIRCULARS describing the
ıd stationary water tube boilers and the feedwater
nufactured by the Mosher Water Tube Boiler Co.,
ay, New York, have been received. The arrangement of tubes in type "A" boiler is somewhat different from that of most water tube boilers and gives the boiler a peculiar appearance. A full description of this boiler is given in the circular.

A NUMBER of advance circulars describing the different types of valves and fittings manufactured by the Crane Co., Chicago, have been received. Those particularly mentioned in these circulars are Crane combination back pressure and exhaust relief valves, Crane butterfly hot water radiator valves, Crane automatic exhaust relief valves, Crane renewable spring disk brass valves, globe, angle and cross patterns, and Crane flange pipe joints.

I. P. MORRIS & CO., Philadelphia, have sent us a copy of Bulletin No. 1, which describes their different types of turbine machinery. It also gives a complete description of the plant of the Niagara Falls Power Co., which is equipped entirely with turbines manufactured by this company. Other plants described are those of the Niagara Falls Hydraulic Power & Mfg.Co., the Canadian & Niagara Power Co., the Trenton Falls plant of the Utica Gas & Electric Co. and the plant of the Shawinigan Water & Power Co. It also describes their heavy centrifugal pumping machinery.

A CATALOG issued by the Golden-Anderson Valve Specialty Co., 200 Pike street, Pittsburg, Pa., very satisfactorily describes and illustrates their specialties, among which are the Anderson cushion nonreturn valve, the Anderson combination cushion nonreturn valve, the Anderson cushion triple acting nonreturn valve, the Anderson patent pressure reducing valve, the Anderson patent automatic and counter balanced valve, the Anderson patent automatic valve and water column for railroad service, the Golden automatic tilting steam trap.

A BOOKLET describing the different specialties, among which are several kinds of packing, belting, pump valves, scraping and packing tools, etc., manufactured and for sale by the Strong Machinery & Supply Co., 48 Franklin street, New York, has been received. Along with this booklet is a circular devoted to the description of Strong's Rivalate metallic packing which is said to be steam, oil, acid, gas and ammonia proof and almost wear proof. For a further description of any of this company's specialties write them at the above address.

"AMERICAN BALL ENGINES" is the title of a very handsome catalog issued by the American Engine Co., Bound Brook, N. J. The first part of this catalog is given over to the description of the different parts of the American Ball engine, some of which are common to both the simple and compound types. After that the peculiar features of the simple and compound engines are separately considered. The illustrations are excellent and every part is shown to the smallest detail. Any engineer not familiar with the construction of the American Ball engine should obtain a copy of this catalogue from the manufacturers.

ALBANY GREASE, the different purposes for which it can be used, directions for placing and ordering cups and the different kinds of cups furnished are incorporated in a booklet issued by Adam Cook's Sons, 313 West street, New York. In order to introduce Albany grease where it has not already been tried and is known, the manufacturers agree to send a sample of Albany grease and a grease cup free so that a trial can be made. The only information necessary to send in requesting a sample, is pipe connection in bearing, depth of oil hole from top of cap to journal. Also mention the particular part of machinery on which the test is to be made.

THE OHIO BLOWER CO., Dept. S-3, Cleveland, O., have issued a folder which is intended to prove that the Swartwout exhaust head gives satisfaction and meets with the approval of large manufacturing concerns. On the left hand page is shown the photograph of an order for four exhaust heads for the National Tube Co., Pittsburg. It is dated Jan. 5, 1905. On the opposite page is the photograph of another order, from the same company, for eleven exhaust heads. This order is dated July 3, 1905, nearly six months later. It is reasonable to suppose that the second order would not have been given if the first heads were not satisfactory. The Ohio Blower Co. will be pleased to correspond with any company requiring an exhaust head.

WE HAVE RECENTLY RECEIVED from the Burt Mfg. Co., Akron, O., a very handsome catalog which describes in detail the various oil filters and exhaust heads manufactured by this company. The Burt Mfg. Co. claim to be the largest manufacturers of oil filters in the world, and their new catalog has been conceived and executed on a scale which accords with their reputation, as it is said to be the largest and handsomest catalog of this class of goods which has ever been issued. It illustrates and describes the Cross, American and Warden oil filters, the American oil filtering system, and the Burt and Standard exhaust heads. The valuable information which it contains in reference to the filtering of oils makes it a valuable work of reference, worthy a place on the desk of anyone operating a power plant. It also describes fully the Unit Type of oil filters, which is used in connection with the American oil filtering system. Everyone interested in the running of a power plant is invited to write the Burt Mfg. Co., 228 Main street, Akron, O., for a copy of this handsome publication.

TRADE NOTES.

THE INGERSOLL-SERGEANT DRILL CO. announce that on July 31 their main offices were removed from 26 Cortlandt street, New York, to 11 Broadway.

THE BUSINESS of the Criss-Cross Tube Cleaner Co., Clinton, Mass., has been purchased by Ewd. F. Fletcher & Co. The cleaners will hereafter be manufactured by them under the firm name of the Reversible Tube Cleaner Co., at Worcester, Mass.

THE BURT Mfg. Co., Akron, Ohio, who make the well-known Cross oil filters, have developed what is probably the largest export business in this line in the world. They have recently made a shipment of five oil filters to their agency at Helsingfors, Finland; also 3 large shipments to their representative at Havana, Cuba; also 4 filters to customers at Valparaiso, Chili.

A. C. LIPPINCOTT, general manager of the Indicator Instruction Co., Newark, N. J., reports that the vice president, Mr. Hollister, before returning from the Louisville convention, established a Chicago office at 95 and 97 Washington street. The company are much gratified at the numerous inquiries resulting from the exhibit, which was probably the largest showing of indicators ever seen. The company have just shipped 2 indicators to Japan, 2 to Hawaii, 3 to South African and 10 to Canada.

WE LEARN THAT the Lagonda Mfg. Co., Springfield, Ohio, have been so over crowded with orders that it was necessary for them during the month of July to run their factory all night most of the time, employing two sets of men for operating machines and doing bench work. This, following a recent addition to their factory, certainly looks very favorable for the Lagonda Mfg. Co. They make Weinland tube cleaners, Lagonda tube cutters, damper regulators, and reseating machines and make a specialty of contract work in cleaning boilers.

A NEW COMPANY has been organized and incorporated under the laws of the state of Illinois for the purpose of doing a power plant and factory equipment business in addition to a general jobbing of mill, factory and railroad supplies; packings of all descriptions, small tools and hardware specialties for the engineer, mechanic and carpenter. This company are called the Calumet Supply Co., and are located at 411-413 Dearborn street, Chicago. The active members of the company are J. S. Ward, president and general manager, and Frank M. Gilmore, vice president. These men have been identified with this field for a number of years and enjoy a large acquaintance with the trade. We bespeak for the new company a successful career.

OBITUARY.

Mr. Frederick Schuchman, president and general manager of the Homestead Valve Mfg. Co., died at his home at Homestead, Pa., Tuesday, July 25, 1905.

SALESMAN WANTED.

Traveling among engineers to sell France metallic and fibrous packings. Good inducements in unoccupied territory. Address France Packing Co., Tacony, Philadelphia, Pa.

ENGINEERS' LICENSE—Engineers, electricians, firemen and machinists send for 52 page pamphlet, describing Spangenberg's Steam & Electrical Engineering, just out; best book ever published, sent FREE. Geo. A. Zeller Book Co. No. 26 S. 4th St., St. Louis, Mo.

The Relief Valve.

"What is the secret of success?" asked the Sphinx.
"Push," said the Button.
"Never be led," said the Pencil.
"Take pains," said the Window.
"Always keep cool," said the Ice.
"Be up to date," said the Calendar.
"Never lose your head," said the Beer.
"Make light of everything," said the Fire.
"Do a driving business," said the Hammer.
"Aspire to greater things," said the Nutmeg.
"Be sharp in all your dealings," said the knife.
"Find a good thing and stick to it," said the Glue
"Do the work you are sooted for," said the Chi

"I've been spending the summer at a waterin
"Why, Harry told me you were on a farm." "Y
was a dairy farm."

He—"There is one woman in the world who
me for rendering her happy for life."
She—"Why, I didn't know you were married."
He—"I'm not; I broke the engagement."

"My dear," said Mrs. Henpeck, "I'm positive
George is thinking seriously of matrimony."
"Well, I only hope so,' returned Henpeck, wit
spirit. "I wouldn't want any boy of mine to be
tunate as to regard it as a joke."

A Scottish beadle one day led the manse housem
churchyard, and pointing with his finger, stamme
folk are buried there, Jennie. Wad ye like to be bu
too?" It was his way of popping the question.

An old Scottish farmer, being elected a memb
local school board, visited the school, and tested t
gence of the class by his questions. The first inq
"Noo, boys, can ony o' you tell me what naethin
After a moment's silence a small boy in a back
and replied:
"It's wha ye gie me t'other day for haudin' yer
Exchange.

The son of a certain German farmer found, in get
for mill, that the sack of grain would ride just as
horse's back by dividing the load as by putting a s
one side and the grain on the other. So he called h
attention to the improvement. But this improveme
innovation, and his father said: "Hans, your vater
grandvater and wour greatgrandvater vent to mil
shtone in der sack, und vat vas good enough fo
good enough for you. Put back dot shtone."—*Ex*

The other day a well-known counsel examining th
in a breach of promise case inquired of her: "W
fendant's air when he promised to marry you perfec
or one of levity and jocularity?"
The complainant replied: "If you please, sir,
ruffled with him running his hands through it."
"You misapprehend my meaning," said the couns
the promise made in utter sincerity?"
"No, sir; it was made in the wash-house," replied
tiff, amid roars of laughter.

Wilson: "Here's a problem for you, old man.
was tied to a rope 6 feet long; 18 feet away
a bundle of hay, and the donkey wanted to get t
How did he manage it?"
Sharp: "Oh, I've heard that one before. You w
say, 'I give it up,' and you'll say, 'So did the othe
Wilson: "Not at all."
Sharp: "Then how did he do it?"
Wilson: "Just walked up to the hay and ate it."
Sharp: "But you said he was tied to a rope 6 f
Wilson: "So he was. But you see the rope was
anything. Quite simple, isn't it?"

THE C. & G. COOPER CO.
MT. VERNON, OHIO.
BUILDERS OF
Cooper Corliss Engines
ALL TYPES AND SIZES.
COMPLETE STEAM PLANTS A SPECIALTY.

NEW YORK, 1430 Bowling Green Bldg.; BOSTON, 411 Weld Bldg.; PHILADELPHIA, 820 Drexel Bldg.; ATLANTA, 315 Empire Bldg.; NEW ORLEANS, 217-231 Gravier St.; CHARLOTTE, N. C., O. A. Robbins.

Model Automatic (Stoker) Furnace
Patented in 1903.

Gives 10 to 15 per cent better economy 15 to 25 per cent greater capacity than any other type.

Cleans automatically and wastes less fuel in the ash, than any other, whether mechanical or hand fired.

Write for Illustrated Circular B.

Model Stoker Company
DAYTON, OHIO

LUBRON PACKINGS

are specially treated with

(TRADE)
LUBRON.
(MARK)

They outwear and outlast all others and are self lubricating. If your packings give you trouble send us an order. If your packings work all right try ours once, they will work better. The only fault we find with our goods is that they wear too long.

The Lubron Mfg. Co.
88 Broad Street,
Dept. S. BOSTON MASS.

KEEP YOUR FEED PIPE CLEAR OF LEAVES, STICKS, FISH, ETC. BY USING

An Automatic Self-Cleaning Foot Valve

WE KNOW WHAT THIS VALVE CAN DO AND WILL GUARANTEE RESULTS.

You can clean it quickly and thoroughly without leaving the engine room.

No plant taking its boiler feedwater from a river, lake or pond can afford to be without this valve.

SEND FOR CIRCULARS AND PRICE LIST.
L. & D. FOOT VALVE CO.
353 S. Front Street GRAND RAPIDS, MICH.

DIRTY BOILERS and CORRODED TUBES are not necessary.

INTERNATIONAL Boiler Compound

will keep the tubes and shell clean. If you doubt it, send for a trial order. We have a special proposition for engineers. Write for it.

International Boiler Compound Co.
47 Market Street, CHICAGO, ILL.

THE LAST CHANCE

to take water out of Live Steam is at the throttle. We make several styles of

AUSTIN Steam Separators

designed to be installed as shown above, giving

Three Great Advantages

PATENTED
AUSTIN
SEPARATOR CO.
DETROIT, MICH.

Fig. "H" Vertical

DRY STEAM — Increased efficiency in the engine. Over 99.5% dry steam proven by test.

STEAM STORAGE—Extra steam instantly available for sudden increases of load. In many plants the use of a steam separator that also acts as an accumulator is invaluable.

ENGINE INSURANCE—A large Austin receiver separator properly drained—for this purpose use a good steam trap—gives absolute protection against water entering the engine cylinder either in large or small amounts.

Figured in any of these three ways an Austin Separator earns steady dividends on its cost. And we let you prove it to your own satisfaction before a cent of money changes hands. Catalogue illustrates and details the complete Austin line of separators for live or exhaust steam. *SEND FOR IT.*

Austin Separator Co.

90 Woodbridge St., Detroit, Mich., U. S. A.

The Reliance Steam Tr

PERFORMS ITS DUTY ALL THE TIME.

When it comes to you it is fi
ready.
Connect it up, set it at work an
get it. It needs no attention, no ti
ing, no fussing with There's no
about it to get "out of whack"
will last practically forever.

You might be interested in the catalogue.

The Reliance Gauge Column
86 E. Prospect Street,
CLEVELAND, OHIO.

Steam Traps Save C

RETURN STEAM TRAP

This company man
Steam Traps for all
Return Steam Traps
turning the water of c
ation back into the bo
der pressure, without
of a pump, and no
steam traps for dischar
water into a tank or
phere and preventing
cape of steam from the
SEND FOR CATALOGU

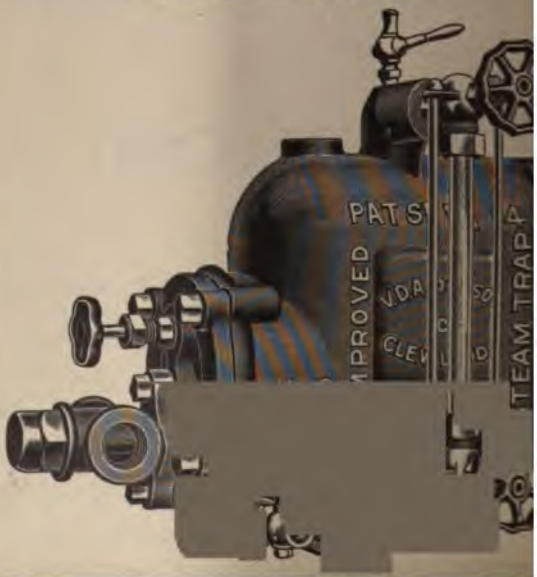
The Albany Steam T
Albany, N. Y., U. S
Established 187
Fred'k Townsend, Pre
Jas. H. Blessing, Ge

The Standard Steam Trap of Americ
IS THE

ANDERSO

MANUFACTURED BY

THE V. D. ANDERSON CO
CLEVELAND, OHIO.



Vorth Wins" AND THE
olden Tilting Steam Trap
on its merits. Made for high or low pressure. It is the
gest trap of its kind on the market. No floats, no valves inside
p to get out of order. Positive and durable.

'e wish to call special attention to the Anderson Non-Return
, description of which will be found in our catalog Send for it.
Golden-Anderson Valve Specialty Co.
PIKE ST. PITTSBURG, PA.

This brings it home

TIGHT CHAIN
like a tight belt; hard work, high friction and lost power.

LOOSE CHAIN
like a loose belt with Cling-Surface; easy, cool bearings, relief at all points, no lost power.

Turn your bicycle upside down, tighten the chain and revolve wheel by hand.

Next loosen the chain and do it again.

You know the great difference.

It is exactly the same with every tight belt you run. You were the engine and you can see the drag you put on your real engine from tight belts.

Cling-Surface lets all belts run easy, carry fullest loads, preserves them and saves oil, babbit, belts, power, fuel, time and labor.

We guarantee it.

First order sent subject to trial. Send for one.

Cling-Surface Co
154-160 Virginia St
Buffalo N Y
Branches in Chief Cities.

STEAM PIPES THAT SPATTER ROOFS

Does this suggest a condition that exists in your own plant? A constant drizzle of oil and water from the exhaust pipe. Decay of roof. Spattered walls. Wet sidewalks. Annoyance to passersby and injury to their clothes.

A Wright "CYCLONE" Exhaust Head
Would Stop All This!

The "CYCLONE" is a perfectly proportioned head. Extremely heavy and durable, and made to last for years. It cannot cause back pressure, all steam passages being ample, giving a full, free course to the steam, which issues light and dry and without noise.

Don't buy an exhaust head until you have studied the construction details of the WRIGHT "CYCLONE" Send for leaflet.

WRIGHT MANUFACTURING CO.
2 Woodbridge St. - - - DETROIT, MICH., U. S. A.

A 16-INCH

Swartwout Cast Iron Exhaus Head

on the 16-story office building of the Columbus Savings and Trust Company. Columbus, Ohio.

The Ohio Blower Co.,
Cleveland, Ohio.

Gentlemen: Your inquiry of recent date at hand. In reply I am pleased to say that we have had one of your 16-inch "Swartwout" cast iron exhaust heads in use on the Columbus Savings & Trust twelve story office building since the boilers were fired and the same is giving entire satisfaction. Yours very respectfully,
F. L. PACKARD.

The Swartwout Vertical Steam Separator

Simple and efficient, yet moderate in price. Guaranteed to be perfectly satisfactory.

The Ohio Blower Company,

Sole Manufacturers,

Cleveland, Dept. S-3 **Ohi**

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This library is intended for Engineers and assistants who may desire to obtain a thor knowledge of the principles and practices of modern Steam Engineering and Electricity. T works are now accepted as standard and are the most helpful books published as up-to-date helps for busy men. Convenient in size and fully illustrated, handsomely bound and are su on one dollar monthly payments to responsible parties.

Some of the subjects treated are explanations and the mathematics of engineering with amples, measuration, algebra, firing of boilers, boiler repairs, pump management, steam hea plumbing, steam engine running, and construction, valve setting, taking indicator cards gineers' examinations (with questions and answers), dynamo and motor management, and structions for operating an electrical plant, and instruction in self help mechanical drawing

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The books are sold on easy payments; the set, seven volumes, price $12.00, will be sent, press prepaid, to any address on receipt of $1.00, and agreement to pay balance in monthly stalments of $1.00. Each volume is complete in itself; one, two, three, four or five books of series will be sent on the same easy terms, that is, one dollar with order and remainder of purchase money $1.00 monthly. Complete description of books sent free on request.

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(E.R.)I accept your offer to supply me with HAWKINS' ENGINEERS' LIBRARY (seven umes) for $12. Enclosed find $1 as part payment; the balance I promise to remit in $1 m installments.

You are at liberty to consult the person named below as to my reputation for keeping business promises.

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Address....................................

Name....................................

Occupation....................................

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Send Postal for Engineers' Catalog. **THEO. AUDEL & COMPANY, PUBLISHERS.** **63 Fifth Avenue, New Y**

Starrett Speed Indicator No. 104

Price, Postpaid, $1.00

This Indicator may be run at highest speed required, without heating. The working parts are encased. Dial has two rows of figures, reading either right or left as shaft may run. Steel pointed spindle with rubber tips for both pointed and centered shafts. The 0 mark may be instantly set at the starting point.

Send for free Catalogue No. 171 of Fine Tools.

The L. S. Starrett Co., Athol Mass., U. S. A.

A VALUAB CATALOGU

"Graphite Lubricant

FREE ON REQUEST

EVERY ENGINE SHOULD HAVE FOR REFEREN

Joseph Dixon Crucible Co. **Jersey City, N.**

Keep Tabs on your Oil Bills

We can sell you an oil filter that will save four times its cost every year.

An Acme Oil Filter

and will send it to you on

30 Days' Trial

prove up. If it does not filter more and do it better than any other filter the same capacity, don't keep it, send back at our expense.

Walter L. Flower Filter Co.

1011 Chemical Building,
ST. LOUIS, MO.

One for *me*
One for the *Oil Company*

Thousands of lubricating oil users have, with the help of the

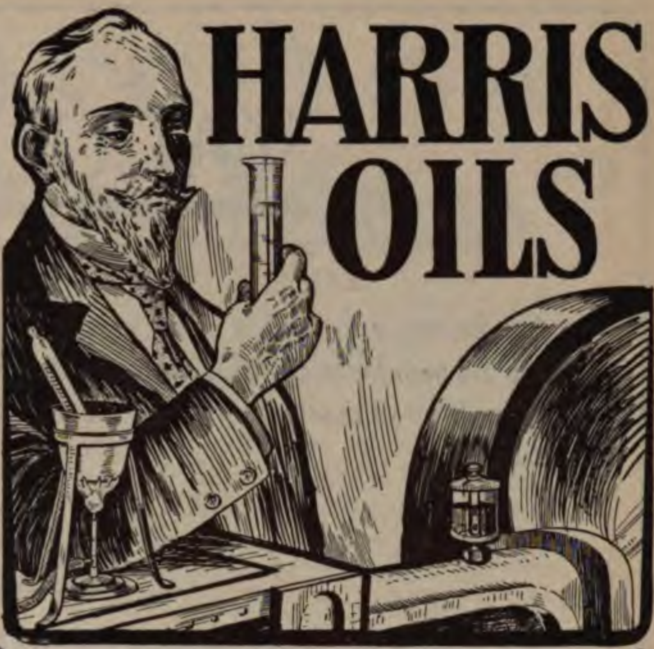
WHITE STAR OIL FILTER

ut their oil bills squarely in two.
This economic power plant fact is one of vital importance to very careful manager—easily demonstrated—quickly proved.

We will be pleased to send a sample Filter on 30 days' trial FREE. If it does the work you keep it, if not, send it back.
Booklet "J" tells you all about this perfect and practical device.

PITTSBURGH GAGE & SUPPLY CO.
PITTSBURGH, PA.

IL FILTRATION EXPERTS.



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We adapt oils scientifically for the purpose for which they are to be used.

Producing satisfactory cylinder lubricants involves many factors, which we have carefully studied.

Oils possessing the cohesiveness to resist the volatilizing effect of high temperature in the high-pressure cylinder of a compound engine, would be unsatisfactory in the low-pressure cylinder, with its low temperature, slow motion and great weight of parts.

We offer a most liberal proposition, enabling any engineer running a compound engine to try **Harris High Pressure Valve Oil** for the high pressure and **Harris Low Pressure Valve Oil** for the low pressure side. For simple engines try **A. W. H. Valve Oil** for internal and **A. W. H. Engine Oil** for external working parts.

A. W. Harris Oil Co.

South Water Street,
PROVIDENCE, R. I.

TATUM & BOWEN, 36 Freemont St., San Francisco,
Pacific Coast Agents.

VACUUM OILS

Are known and used in every corner of the globe where machinery runs. They are the standards of value throughout the whole world. They lubricate most on every kind of machinery; not the same oil for all machines, but the right oil for each class.

VACUUM OILS

Are made to fit every condition. That is why they are used wherever machinery is in operation. Admiral Dewey's fleet used them at the Battle of Manilla. The best users everywhere will have no others when they know their value.

VACUUM OILS

Are made at Rochester and Olean, N. Y., and distributed throughout the world from local branches. Abroad they are distributed from ***one hundred and twelve foreign warehouses,*** and at home they are sold in ***every city.*** The reason

VACUUM OILS

Are everywhere used is—they lubricate most. They reduce friction to the limit and save power. They are always uniform and can always be depended upon. They do their work better than all others, and cheaper, too, when the work done is figured. Other oils may sell for less by the gallon, but

VACUUM OILS

Cost the least by the day or month.

VACUUM OIL COMPANY, Rochester, N. Y.

plex Indicator

: as it Goes to Students

d, oak case, cock and spring guarantee, and finished and plated as carefully .00 outfits; (wheel not included, but is remium for a little work.)

dicator Instruction Co.

: this instrument with their rse, free of any further expense

commences at the bottom, and carries forward to the TOP and tells him the herefores by means of simple weekly iere is a lot in this course which has e been printed. See prospectus for

ied Representatives

). In planning for our "Fall Com- e will need a few hustling sales- can "do business." If you can te your ability, and prove your tation, we can probably talk a money roposition to you. Anyone who this course would probably have lling gold dollars for 58 cts.

est improvements in **Indicators, Re- eels** and **Planimeters** may be had

t Steam Specialty & Supply Co.

EWARK, NEW JERSEY.

ICE! "New Catalog."

Are You The Man?

who has, for several months back, felt like writing for a prospectus of our Course of Indicator Instruction, with a fine Indicator included, but who has not done so? Have you talked to yourself about like this?—"I can't believe that this concern can give an Indicator on this plan, without any strings to it, and, if they do, it is doubtless a cheap, flimsy affair, just good enough to take a few imitation diagrams, and then the 'top shelf.' I don't believe there is anything in the course that I won't find in my $1.00 indicator book, 'How to learn all about the indicator in thirty minutes,' etc., etc." IF YOU ARE THE MAN who has been talking in this way, you have been losing a good thing, for, while you have slumbered, we have been enrolling students from every State in the Union, and in Canada, Mexico, Hawaii, West Indies, South Africa and India, and have been sending out those fine Simplex Indicators, sometimes twenty in one day. If you don't believe it, write to Wells-Fargo Express Company manager, of Newark, and see what he says. Every student is delighted. Student Maage, of Hawaii, writes that he has carefully compared it with a $55.00 instrument owned by his company, and likes the Simplex much better. What is more, we can refer you to a thousand other engineers, which ought to convince you.

Do you think you would wish to sell this knowledge, and indicator, for three times what we charge, after you graduate, and get one of our fine diplomas? We think not! At any rate, it only costs you a couple of pennies to mail this coupon, and if what we send you is not worth the money, we will send it back at once. This is a perfectly "square deal" all the way through, and we want YOU in the class this fall. **"I. I. C."** buttons are now worn all around the world, so you will be in good company.

If you will agree to devote 10 hours' faithful work to our cause before October 10th, we will tell you how you can earn a FINE PLANIMETER, and some MONEY. If interested, tear this off with coupon.

TEAR OFF ALONG DOTTED LINE AND MAIL TODAY.

A. C. LIPPINCOTT, Gen,l Mgr., DATE..........
Newark, N. J.

Dear Sir—Without any further obligation on my part, please send me full particulars of everything on this page. I will consider enrolling about..........

paying $.......... down and $.......... per month.

WRITE PLAINLY.

NAME.......... CITY..........
COUNTY.......... STATE..........
BOX NO.......... (Eng. Rev.)

Read these Letters, Mr. Engineer, they are from a Concern which Claimed their Boiler Tubes were Free from Scale.

Brunswick, Me., Feb. 3, 1905.

Wm. B. Pierce Co.

Dear Sirs:—Your favor of the 31st at hand and contents duly noted. We do not have any scale on our tubes and I do not see how your cleaner could help us very much, but I would like a little further information on the subject and await your reply.

PEJEPSCOT PAPER CO.,
F. C. Whitehouse, Treas.

Brunswick, Me., Feb. 13, 1905.

Wm. B. Pierce Co.

Dear Sirs:—Your favor of the 7th is at hand and contents duly noted. You may send us one of your cleaners 3½ inch tube, on the conditions as stated in your letter and we will give it a trial. As stated in our last letter, we have the feeling that it will not give us any benefit but quite agree wit that there would be no particular loss in trying it.

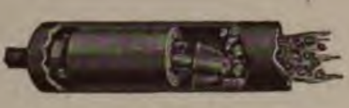
PEJEPSCOT PAPER CO.,
F. C. Whitehouse, Tre

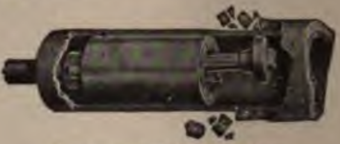
Brunswick, Me., March 2, 190

Wm. B. Pierce Co.

Dear Sirs:—We received the Tube Cleaner at Pejepscot mill, invoiced by you on the 15th ult. and it much better work than we anticipated. We have deci give you an order for another one, 3½ inch tubes, the one sent to our Pejepscot mill. Please forward address, Lisbon Falls, at your earliest convenience and obl

LISBON FALLS FIBRE CO.,
F. C. Whitehouse, Trea


For Water-Tube Boilers.


For Return Tubular Boilers.

Now, Mr. Engineer, possibly the conditions are the same with you.

You believe you have no scale and "the cleaner will not help you very much," but isn't it worth the trial to see if there is not scale on your tubes when the trial costs you nothing?

No matter what device you may be using, we will loan you a cleaner for trial.

Use it on a return tubular or a water tube boiler, and you will probably be as much surprised as was the writer of the three letters above.

Don't hesitate to except this trial offer. It doesn't ob gate you to make a purchase and you can return the clea after trial if you so desire.

The Dean Boiler Tube Cleaner illustrated above, is described in a book which we issue, entitled "Boiler Ro Economy." We shall be pleased to send this book to without cost. Write for it today.

In sending trial order for the cleaner do not overl sending us the size of your boiler tubes.

WM. B. PIERCE CO.
325 Washington St., Buffalo, N.

Classified Index for Buyers.

For addresses of manufacturers refer to the Alphabetical Index on page 49 which gives the pages on which the advertisements appear.

Air Compressors
Quincy Engine Wks
Snider-Hughes Co.

Air Compressors, Gasoline
Columbus Machine Co.

Alarms, High and Low Water
Crane Co.
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Arch Plates, Boiler
Lamprey Co.

Automobile Fittings
Lunkenheimer Co.

Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.

Belting
Chicago Rawhide Mfg. Co.
France Packing Co.
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.

Blowers
Ohio Blower Co.
Snider-Hughes Co.

Boiler Compound Feeders
International Boiler Compound Co.

Boilers
Aultman & Taylor Mch. Co.
Cooper Co., C. & G.
Harrison Safety Boiler Works.
Holyoke Steam Boiler Works.

Boiler Tube Cleaners, Mechanical
Bushnell & Co., John S.
General Specialty Co.
Lagonda Mfg. Co.
Maurer, Labadie & Co.
Pierce Co., Wm. B.

Books
Audel & Co., Theo.
Engineers' Review Co.

Boring Machines, Electric
McCrea & Co., Jas.

Brass Founders
Williams Valve Co., D. T.

Calipers
Starrett Co., L. S.

Castings, Brass
Pittsburg Gage & Supply Co.

Chemicals
Lord Co., Geo. W.

Clamps, Pipe
McCrea & Co., Jas.

Clamps, Steam Joint
McCrea & Co., Jas.

Cocks
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Cocks, Gas
Pittsburg Gage & Supply Co.

Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.

Commutator Lubricants, Graphite
Dixon Crucible Co., Jos.

Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.

Compounds, Car Axle
Lubron Mfg. Co.

Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.

Compounds, Lubricating
Keystone Lubricating Co.

Condensers
Snider-Hughes Co.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Cooling Towers
Wheeler Condenser & Eng. Co.

Counter shafts
Myers & Bro., F. E.

Cutters, Gasket and Washer
McCrea & Co., Jas.

Cutters, Tube
Lagonda Mfg. Co.

Cylinders, Artesian Well
Myers & Bro., F. E.

Cylinders, Irrigation
Myers & Bro., F. E.

Dividers
Starrett Co., L. S.

Disks, Rubber
Peerless Rubber Mfg. Co.

Dry Kilns
Ohio Blower Co.

Dust Collectors
Ohio Blower Co.

Dynamo and Motor Brushes, Graphite
Dixon Crucible Co., Jos.

Ejectors
American Injector Co.
Chicago Injector Co.
Penberthy Injector Co.

Engines, Blowing
Buckeye Engine Co.

Engines, Gas and Gasoline
Buckeye Engine Co.
Columbus Machine Co.

Engines, Gasoline Hoisting
Columbus Machine Co.

Engines, Hoisting
Quincy Engine Wks.

Engines, Steam
American Engine Co.
Bates Machine Co.
Buckeye Engine Co.
Cooper Co., C. & G.
Ohio Blower Co.
Quincy Engine Works.
Reeves Engine Co.
Russell Engine Co.

Exhaust Heads
Burt Mfg. Co.
Flower Filter Co., Walter L.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.

Fertilizer Dryers
Anderson Co., V. D.

Filters, Oil
Burt Mfg. Co.
Flower Filter Co., Walter L.
Lippincott Steam Spec. & Sup.
Maurer, Labadie & Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.

Filterers, Scale
Wright Mfg. Co.

Fittings, Brass Hydraul
Pittsburg Gage & Supply Co.

Fittings, Steam
Lunkenheimer Co.
Sterling Lubricator Co.

Floats, High Pressure
Reliance Gauge Column Co.

Flue Cleaner Rods
McCrea & Co., Jas.

Flue Cleaners
Bushnell & Co., John S.
Cleveland Flue Cleaner Mfg. C
Robertson & Sons, Jas. L.
Ruggles & Ruggles.

Foot Valves
L. & D. Foot Valve Co.

Furnace Feeders
Ohio Blower Co.

Furnace, Patent
Holyoke Steam Boiler Works.

Fusible Plugs
Lunkenheimer Co.

Gage Glass Reflectors
Lubron Mfg. Co.

Gage Glass Rings
Pennsylvania Rubber Co.

Gages, Oil
Lunkenheimer Co.

Gages, Steam
Chicago Injector Co.
Pittsburg Gage & Supply Co.

Gages, Recording
Pittsburg Gage & Supply Co.

Gages, Water
Lunkenheimer Co.
Penberthy Injector Co.
Powell Co., Wm.
Reliance Gauge Column Co.

(Continued on page 56.)

There is only ONE

ALBANY GREASE

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Can be used in every style of grease cup made, which cannot be done with *any other* lubricant.

Cost of using Oils
Cost of using ALBANY GREASE

We solicit your inquiries.
We guarantee satisfaction.
Write us or call.

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

rade mark
y package

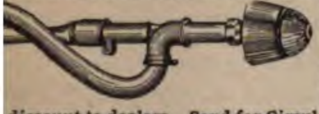
ADAM COOK'S SONS,

313 West Street, NEW YORK CITY, U. S. A.

---

eveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.



Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

discount to dealers. Send for Circular and Price List of Cleaner
se. **Room 13, 74 Frankfort Street, CLEVELAND, OHIO.**

RANE FITTINGS
ESTABLISHED 1855

Days
ial

To Prove Our Claims

RUGGLES
rfection Flue Cleaner

is the simplest cleaner on the market and is one of the most efficient. No screws or rivets used in its construction. Sharpens itself.

Strong and reliable.

Send for one on trial.

uggles & Ruggles

BATAVIA, ILLINOIS.

"Lightning Tube Cleaner" Features

1—Cleans scaled tubes inside or outside.
2—Propelled by water, air or steam.
3—Does the work quick.
4—Saves $2.00 every 10 hours run metered water bill.
5—Motor Wheel utilizes a compound power.
6—Construction overcomes cone and ball breakage.
7—Has re-sharpening, non-breakable cleaner head.
8—Future repairs, very small item.
9—Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

Sold on approval. Attractive proposition to State Agents.

MAURER, LABADIE & CO.
215 St. Joe Street, South Bend, Ind.

If Your Coal Consumption Is Bigger Than It Ought To Be

it's a sign that your boiler tubes are accumulating a coat of scale. You may not be able to prevent the scale from forming, but you can keep your tubes free from it by systematic use of

Weinland Tube Cleaners

You can save coal too, by using our DAMPER REGULATOR and a lot of time and money by using our TUBE CUTTER.

We would like to talk with you about everything in our line.

THE LAGONDA MFG. CO.

Boiler Cleaning Experts,
At it 20 years.

SPRINGFIELD, OHIO.

New York Chicago Pittsburg
Philadelphia St. Louis London

BOILER CLEANING MADE EASY

THE "TORPEDO"

FOR FIRE-TUBE BOILERS

The "Torpedo" is the most remarkable pneumatic or steam-driven tool in the world. The old idea of cleaning fire tube boilers was to hammer the inside of the tubes. The "Torpedo" *vibrates* the tube instead.

The result: Tubes are cleaned more thoroughly, more quickly and absolutely free from any injurious strains.

Think of it: The "Torpedo" produces over 11,000 vibrations a minute, this marvelous rapidity being due to the direct application of the pressure to the piston without valves or ports and also to the extremely short stroke (never exceeds ⅜ inch).

If a trial of the "Torpedo" can not prove that it can save its cost within at least 6 mos., don't buy it. Let us send you one on a free trial anyway.

THE "DEMON"

FOR WATER-TUBE BOILERS

The "Demon" represents the highest type of development in the water motor. While entirely self contained, its motor by actual test develops 42 times the power of a turbine motor.

Why: Because the water transmits its power to the shaft by means of pistons, not open inclined blades, that lose 95 per cent of the water pressure.

The rotary force produced by the "Demon" is the area of the piston multiplied by the water pressure, yet the water consumption is exactly in proportion to the speed of rotation and work performed.

After you have tired of weak and inefficient devices, write for a "Demon" on trial and see the end of your boiler cleaning troubles.

THE GENERAL SPECIALTY CO.

73 Carroll St.,
BUFFALO, N. Y., U. S. A.

(Continued from page 54)

Gaskets
Goodyear Tire & Rubber Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Gear Cutting
Chicago Rawhide Mfg. Co.

Gears, Rawhide
Chicago Rawhide Mfg. Co.

Generators
American Engine Co.

Governors, Pump
Albany Steam Trap Co.
Fisher Governor Co.
Foster Engineering Co.

Graphite
Dixon Crucible Co., Jos.

Graphite, Flake
Dixon Crucible Co., Jos.

Grate Bars
Bushnell & Co., John S.
Holyoke Steam Boiler Works.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grates, Shaking
Lippincott Steam Spec. & Sup. Co.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grease
Cook's Sons, Adam.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
Lubron Mfg. Co.

Grinders, Valve
Quaker City Rubber Co.

Hammering Machines, Die Plate
Bates Machine Co.

Heaters and Purifiers, Feedwater
Bates Machine Co.
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
National Pipe Bending Co.
Quincy Engine Wks.
Robertson & Sons, Jas. L.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Heaters, Hot Water House
National Pipe Bending Co.
Stewart Heater Co.

Heating Apparatus
Ohio Blower Co.

Hose
Goodyear Tire & Rubber Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Indicator Instruction
Indicator Instruction Co.

Indicators, Speed
Starrett Co., L. S.

Indicators, Steam Engine
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Injectors
American Injector Co.
Chicago Injector Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.

Lace Leather
Chicago Rawhide Mfg. Co.

Levels
Starrett Co., L. S.

Lubricators
American Injector Co.
Chicago Injector Co.
Detroit Lubricator Co.
Greene, Tweed & Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Penberthy Injector Co.
Powell & Co., Wm.
Sterling Lubricator Co.
Williams Valve Co., D. T.

Lubricators, Automobile
Lunkenheimer Co.

Machinery, Oil Mill
Anderson Co., V. D.

Machines, Drilling
McCrea & Co., Jas.

Machines, Electric Boring
McCrea & Co., Jas.

Micrometers
Starrett Co., L. S.

Mill Equipment, Wire
Bates Machine Co.

Motors
American Engine Co.

Nail Machines, Wire
Bates Machine Co.

Nail Rumblers
Bates Machine Co.

Oil and Grease Cups
American Injector Co.
Bushnell & Co., John S.
Chicago Injector Co.
Detroit Lubricator Co.
France Packing Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Merrill, G. U.
Penberthy Injector Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Oils
Harris Oil Co., A. W.
International Boiler Compound Co.
Lubron Mfg. Co.
Standard Oil Co.
Vacuum Oil Co.

Packing, Metallic
France Packing Co.
Goodyear Tire & Rubber Co.

Packing, Rawhide Hydraulic
Chicago Rawhide Mfg. Co.

Packing, Sheet and Fibrous
Chicago Rawhide Mfg. Co.
Crandall Packing Co.
France Packing Co.
Goodyear Tire & Rubber Co.
Gould Packing Co.
Greene, Tweed & Co.
Lubron Mfg. Co.
Peerless Rubber Mfg. Co.
Patterson Co., D. S.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Robertson & Sons, Jas. L.

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Mound Tool & Scraper Co.

Paint
Dixon Crucible Co., Jos.

Pencils and Crayons
Dixon Crucible Co., Jos.

Pinions, Rawhide
Chicago Rawhide Mfg. Co.

Pipe and Fittings
Crane Co.

Pipe Cutting and Threading Machines
Armstrong Mfg. Co.
Columbus Machine Co.
Toledo Pipe Threading Machine Co.

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Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

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Pumps, Air
Canton Pump Co.
Wheeler Condenser & Eng. Co.

Pumps, Centrifugal
Wheeler Condenser & Eng. Co.

Pumps, Oil
Greene, Tweed & Co.
Lunkenheimer Co.

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Continued from page 56)

thy Injector Co.
t Lubricator Co.

ps, Power
& Bro., F. E.
Engine Wks.
t Heater Co.

ps, Steam
Steam Trap Co.
Pump Co.
cott Steam Spec. & Sup. Co.
Hughes Co.
r Condenser & Eng. Co.

ps, Vacuum
r Condenser & Eng. Co.

s, Steam
thy Injector Co.

cing Wheels
ll & Co., John S.
cott Steam Spec. & Sup. Co.
son & Sons, Jas. L.

lators, Damper
ll & Co., John S.
la Mfg. Co.
son & Sons, Jas. L.

lators, Feedwater
la Mfg. Co.
, G. U.

lators, Pressure
Engineering Co.

ating Machines
la Mfg. Co.

Dressing
urface Co.

Transmission Wheels
Machine Co.

ber Goods
ar Tire & Rubber Co.
s Rubber Mfg. Co.
City Rubber Co.

s, Steel
t Co., L. S.

, Hack
t Co., L. S.

rators, Steam and Oil
Steam Trap Co.
Separator Co.
ll & Co., John S.
Filter Co., Walter L.
on Safety Boiler Works.
& Co., Chas.
cott Steam Spec. & Sup. Co.
Blower Co.
son & Sons, Jas. L.
t Heater Co.

res
t Co., L. S.

le Machines
Machine Co.

m Specialities
son Co., V. D.
da Mfg. Co.
nheimer Co.
Blower Co.
rg Gage & Supply Co.
& Co., Wm.
ce Gauge Column Co.
ms Valve Co., D. T.
t Mfg. Co.

ers, Mechanical
an & Taylor Mch. Co.
Stoker Co.

iners
D. Foot Valve Co.
l, G. U.

rheaters
an & Taylor Machinery Co.

lies, Engineers'
Packing Co.
cott Steam Spec. & Sup. Co.
ce Gauge Column Co.

Measures
tt Co., L. S.

Tools, Mechanics'
Starrett Co., L. S.
Tools, Scraping
Mound Tool & Scraper Co.

Traps, Air
Wright Mfg. Co.

Traps, Steam
Albany Steam Trap Co.
Anderson Co., V. D.
Flower Filter Co., Walter L.
Golden-Anderson Valve Specialty Co.
Lagonda Mfg. Co.
McCrea & Co., Jas.
Ohio Blower Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Trimmings, Engine and Boiler
Powell Co., Wm.

Tubing
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.

Unions
Albany Steam Trap Co.
Powell & Co., Wm.

Valves
Albany Steam Trap Co.
Crane Co.
Foster Engineering Co.
Golden-Anderson Valve Specialty Co.
Lubron Mfg. Co.
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Valves, Blowoff
Lagonda Mfg. Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.

Valves, Gate
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.

Valves, Foot
L. & D. Foot Valve Co.

Valves, Non-return
Golden-Anderson Valve Specialty Co.

Valves, Pump
Lubron Mfg. Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Valves, Reducing
Foster Engineering Co.
Golden-Anderson Valve Specialty Co.

Valves, Tuyere
Lunkenheimer Co.

Varnish
Dixon Crucible Co., Jos.

Watches
Engineers' Review Co.

Water Columns
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
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Water Purifying and Softening Systems
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.

Water Testing Apparatus
Lord Co., Geo. W.

Whistles, Steam
Lunkenheimer Co.
Powell Co., Wm.
Williams Valve Co., D. T.

Wire Pointers
Bates Machine Co.

Working Heads
Myers & Bro., F. E.

Wrenches
Trimont Mfg. Co.

For packing valve spindles, for a tight, neat, lasting job. Use from one strand to as many as the size of the stuffing-box requires.

Good for small rods as well as valve stems.

All ready for use in pound spools of 40 yards. Never hardens, burns or chars, will not grip a rod and never blows.

Its use means not only saving in power and in wear and tear of engine, valve or pump, but of engineers' time.

We will send you a trial spool

FREE

on your request.

Try it; you'll never be without it.

Greene, Tweed & Co.

17 Murray Street
NEW YORK

How is this for a Testimonia

FOR

GOODYEAR-AKRON METALLIC PACKING

Engineers' Dep't,, Century Building,
St. Louis, Mo,, May 1st, 1905.

Goodyear Tire & Rubber Co., Akron, Ohio.

Gentlemen:—In reply to yours of recent date, in regard to the packing that you placed on our Ideal engines, elevators and pumps in May, 1904, I must confess that it has done more than I expected. I have shown same to quite a number of prominent Engineers, the rough conditions of the rod and they admit that is something they did not think any packing could possibly hold, and in fact when placing the order on trial, I did not think your chances were worth thirty cents. I shall only be too pleased to show anyone the true conditions of the rod. Furthermore, the ammonia rod is giving satisfaction above our expectations.

Yours truly,
JOHN MORGAN, Chief Engineer, Century Bldg.

IT IS GUARANTEED FOR PISTON RODS, VALVE STEMS, PUMPS, ETC.

TRY EVERLASTING SHEET for High Pressure, or TIP-TOP (Red) for regular use.

WRITE FOR SPECIAL LIST OF PREMIUMS.

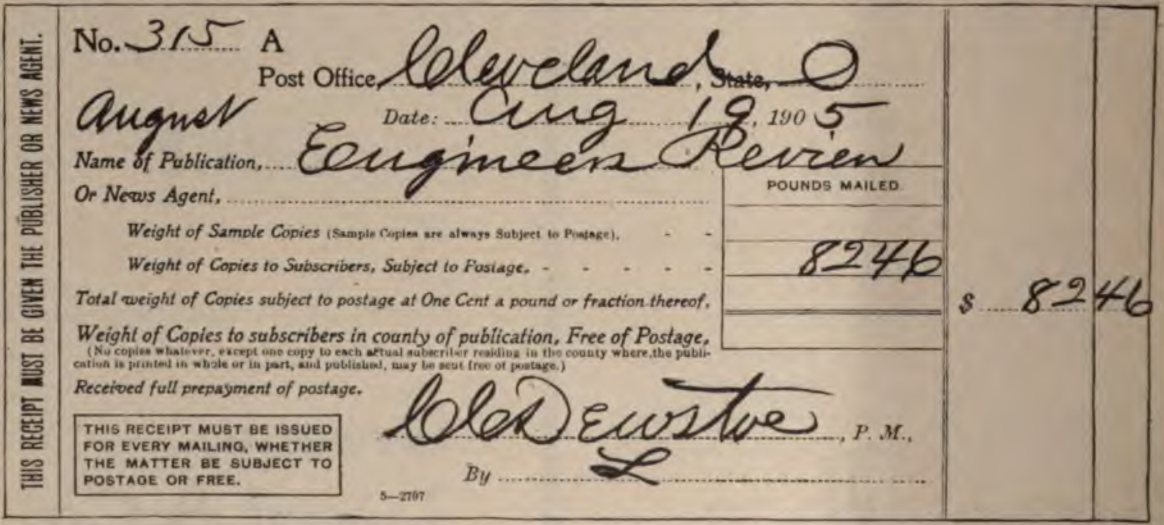
The Goodyear Tire & Rubber Company,

AKRON, OHIO.

The National Steam Specialty Co., 325 Frisco Bldg,, St. Louis, Mo.
James A. Burrows, 220 Sixteenth St., Denver Colo.
J. O. Teagan, Jefferson Ave., Detroit, Mich.

110 Lake St., Chicago, Ill.
253 West 47th St., New York City.
6-8 Merrimac St., Boston, Mass.

ARE YOU SURE that you get all the publicity you pay for? If you are advertisin in the Engineers' Review, you can answer that question with positive "yes." Proof given every month. Below is shown a fac-simile of the Post Office receipt. It is absolute proo See explanation under the cut.



THIS RECEIPT MUST BE GIVEN THE PUBLISHER OR NEWS AGENT.

No. 315 A

Post Office, Cleveland, State, O

August

Date: Aug 19, 1905

Name of Publication, Engineers Review

Or News Agent,

	POUNDS MAILED	
Weight of Sample Copies (Sample Copies are always Subject to Postage).		
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Total weight of Copies subject to postage at One Cent a pound or fraction thereof,		$ 8246
Weight of Copies to subscribers in county of publication, Free of Postage, (No copies whatever, except one copy to each actual subscriber residing in the county where the publication is printed in whole or in part, and published, may be sent free of postage.)		

Received full prepayment of postage.

Ole Dewstoe, P. M.,

By L

THIS RECEIPT MUST BE ISSUED FOR EVERY MAILING, WHETHER THE MATTER BE SUBJECT TO POSTAGE OR FREE.

5—2707

Total number of pounds for Aug. issue	8,246 pound
Deducting wrapping paper	135 "
	8,111 pound
One copy of Aug. issue weighs 6⅜ ounces, making a total number, mailed at the pound rate, of	20,357 copies
Copies mailed in Cleveland under stamps 180 and 163 delivered to our office make an addition of	343 copies
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RAINBOW PACKING

THE ONLY THOROUGHLY RELIABLE FLANGE PACKING IN THE WORLD

SIX MILLION POUNDS OF RAINBOW PACKING

Manufactured and Sold During the Last Three Years

This quantity, one yard wide and one-sixteenth inch thick, would reach from New York to Chicago Junction.

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Eighty-five per cent. of the Power Houses in the United States use the Celebrated Rainbow Packing. What a flattering testimonial of its merit!

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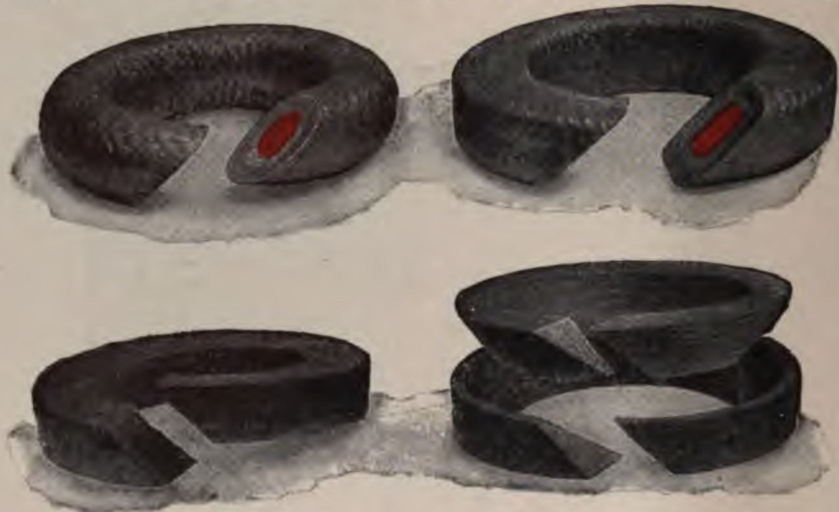

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Selecting a packing for your engine?

It is not altogether a matter of cost, it is a question of accomplishing the desired result.

Pack a stuffing-box properly with

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You know it can be trusted not to harden or leak, score the rod or do any of the disagreeable things other packings will do, and it will wear for the longest possible time.

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Gould's *Steam and U* **PACKI**

In ordering give *exact* diameter of S Box and Piston Rod or Valve Stem.

See that our name and trade mark every package.

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FAIR OFFERS We will send an **Indica** **Reducing Wheel,** or bot ject to examination at e office, to be returned expense if not found to be first class in every detail, or we will send our **Soot Sucker Tube Cleaners,** subject to trial and approval returned if not satisfactory.

THE SOOT SUCKER draws the soot from th tubes without admitting steam into them.

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Complete, convenient and reliable; ready for various press ures without change of spring; guaranteed correct.

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Go Hand in Hand

EUREKA PACKING

Force a pencil through a piece of rubber, draw it in and out, and note the frictional resistance.

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Such being the fact, by what manner of reasoning should an engine packing be used where rubber is on top, on the bottom and in the middle, rubbing at all times against the rods—creating friction, loss in power, fuel, money.

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The rubber is in the center—where it belongs—surrounded by the best of flax and lubricants—never comes in contact with the rod—gives and takes where the rods are uneven or out of line. The flax takes all the wear—the lubricant prevents friction.

For these reasons, it wears longer, is easy to apply and costs much less than any other good, soft packing.

If you are studying economy in your motive department, you want to use EUREKA—Genuine Eureka—sold by all reliable dealers.

A Robertson-Thompson Indicator

is nothing more than a guide post to the engineer. It shows him a short cut to success, better pay and a better position, tells him what to do, when to do, and how to do. Sold on easy terms to engineers.

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Sold on easy terms to suit Engineers

Hine Eliminator

The Hine Eliminator

Every engineer knows what might happen if water accumulated in his cylinder, even if he has never experienced a blown out cylinder head. He also knows what dry steam means in engine efficiency.

A Hine Eliminator in the main steam line will practically dry the steam and when placed in Exhaust line, will extract oil and cleanse condensation.

We make and sell Willis Planimeters, Victor Reducing Wheels, Spencer Damper Regulators, Feed Water Heaters, Shaking Grates and Exhaust Heads.

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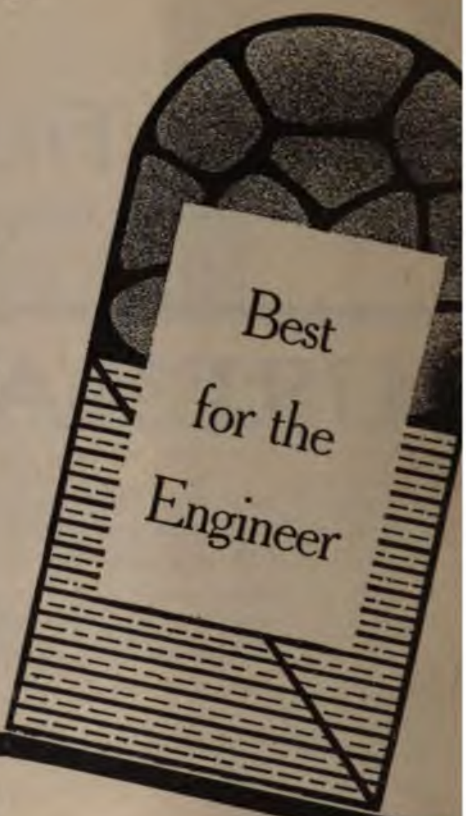

P. P. P.

does more than any other packing towards preserving the life and efficiency of t engine. It is also one of the greatest labor-saving inventions ever given to the enginee

P. P. P. is the self-adjusting packing. That is, there is a packing pressure (the rod only when there is a steam pressure on the packing—and the pressure on tl rod is just strong enough to make the packing tight and no stronger. This reduc friction to the minimum, reduces the amount of steam necessary to produce the requir power, and prevents scored rods. It is also the reason why

P. P. P.

lasts ten times as long as other packings. Think of the hot, disagreeable, after-hou jobs that P. P. P. does away with. The following letter from an enthusiastic engine tells the story :

> Michigan City, Ind., Oct. 27, 1902.
>
> *Gentlemen:*—I am sending you a ring of P. P. P. Packing which has been in use on our 22x42 Corliss engine for a period of 11 months and 10 days. Before using P. P. P. Packing, this engine required packing every two weeks, using four pounds at each packing. R. E. CROCKETT, Chf. Engr.

Like Mr. Crockett, you can pack your engine about once a year now, instead of once in two weeks. Let us send you our booklet showing how P. P. P. saves work.

SEND THE COUPON TODAY.

Q
C
Rubbe
Philade
Gentlemen: Pl
me your booklet
that P. P. P. will sa
Name ________
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St. and No. ________
City ________ *State* ____
Occupation ________
Employed by ________
ENG. REV.

ASK PATERSON

PATERSON HAS "IT"

DOUBLE SERVICE PATERSON'S PACKING

It LASTS TWICE as Long as the Common Kind.

D.S.P. DOUBLE SERVICE PACKING TRADE

D.S.P. DOUBLE SERVICE PACKING MARK

PROVE IT——THAT'S EASY

Remember The Brand

"DOUBLE SERVICE PACKING"

One Grade OUR MOTTO *Best Made*

Without costing the most

ENGINEERS NOTICE

Are you sure the packing which you now use is the best kind suited for your purpose? If you are in doubt, because your packing is giving trouble, our Packing Expert (with 19 years experience) will gladly write you a personal letter, "Solving the Problem."

Simply tell us for what kind of service you want the packing, (Water, Steam, Oil, Ammonia, etc.,) the diameter of rod and stuffing box, also send the label taken from the last box of packing which you bought showing style and brand which does not give satisfaction. There is positively **NO CHARGE** for this information, and **you do not have to buy from us.** We will frankly tell you the best style of packing to buy. The kind best suited to your needs and which will give best results.

It is throwing money away to buy packing not suited for the work it has to do. (We will be pleased to mail a "Double Service" picture with your reply.

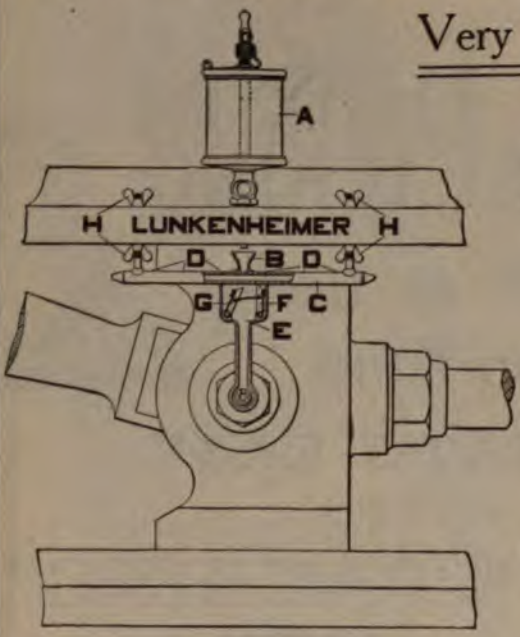
D. S. PATERSON CO.

PHILADELPHIA, PA., U. S. A.

FREE Send us name of Engineer friend having "Packing Troubles" and we will mail picture (very pretty and taken from life), entitled DOUBLE SERVICE. The "Boys" all like it.

IF YOUR DEALER is out of "DOUBLE SERVICE PACKING"—the style you want—send us his name with your order and we will pay all express charges on your shipment.

LUNKENHEIMER H.-W. CROSS HEAD PIN OILERS



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Oil can be fed in any desired quantity.

Can be adapted to any style of engine frame.

Easily attached and regulated.

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Adjustable Threading Device No. 3

can thread any size of pipe from 4½ to 8 in. inclusive.

A labor saver, a durable and efficient tool.

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There are 800,000 of them in use.

More of them are sold than of all other makes combined.

They are used by fully nine-tenths of the prominent American Engine builders.

It requires merit to establish such a record.

Catalogue on application.

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The Powell "White Star" Valve

Is on the shelves of every reliable jobber in Steam Supplies, they are our distributing depots for the convenience of users. The Powell "White Star" represents progress in valves for controlling steam. It is head and shoulders above all other makes. Note the disk—it is regrindable, reversible, renewable, will stand 2000 degrees of heat. Made of a white metal—looks like silver—close grained, tough and wearable, made to a gauge and can be replaced by anyone.

"White Star" valves are made in two weights, one to stand pressure up to 200 pounds, the other 350 pounds. Investigation courted. When next in need of a valve order a "White Star," nothing so convincing as an actual trial.

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STOCKS AND DIES

For Threading Pipe.

Universally acknowledged to be the best on the market.

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NEW IMPROVED ROCHESTER AUTOMATIC LUBRICATORS

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Conditions that are more pronounced every day, make force feed lubrication absolutely indispensable. Most engineers know this, but the one question with them is to secure the best, most durable, most reliable lubricator made. Now, we are willing to lend any engineer a helping hand. We will send on

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A New Improved
Rochester
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with all necessary connections.

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Engineers can depend upon the

Chicago Automatic Injectors

doing what we claim for them.

We have the most extensive testing plant in the United States and each injector is tested under actual conditions before leaving our factory.

Place a Chicago Injector on your boiler and your injector troubles are ended.

The Chicago is for sale by all dealers.

Send for our 1905 catalogue showing our full line of Injectors, Lubricators, Grease Cups, etc.

THE CHICAGO INJECTOR CO.
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IN EVERY BOILER ROOM.

It is the one perfect injector for every type of steam boiler. It is almost as indispensable for the perfect operation of a boiler as the water which it feeds.

It brings satisfaction to every engineer because it brings complete freedom from injector troubles. Its simple and strong construction insures freedom from repair bills makes it easy to keep clean, and is the secret of its well-known reliability. The U. S. Automatic Injector starts at lower steam pressure and works to higher than any other; can be used as lifting or non-lifting injector, and its range and capacity are guaranteed by a certificate accompanying each. Demand the genuine "U. S." Take no substitute.

Some interesting facts about boilers and their care with a few words about injectors, are contained in our famous "Engineer's Red Book" Sent free to all who write. Let us hear from you.

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Great Efficiency Simplicity of Construction and Low Cost

Has a CAST IRON shell which will never wear out; with seamless drawn brass tubes expanded into tube plates at top and bottom, with double blow-off.

The tubes being surmounted by a cap, forming a chamber at the top, and being fastened rigidly only to the lower tube plate, free play is given for expansion, thereby preventing rupture and leakage of joints.

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The Foster
Class "W" High Pressure Regulator

Class "W" High Pressure Regulator

is a standard device for regulating pressures, steam, gas or air, in which the movements of the valve are governed by a diaphragm controlled by compensating springs and levers. It is positive in action and absolutely automatic after adjustment, noiseless and reliable, ensuring uniform delivery pressure, regardless of variation in initial pressure.

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Back Pressure Valve

By dispensing with direct-acting springs or weighted levers, irregularity in back pressure and loss or increase of back pressure through levers pounding themselves loose, are obviated. We offer a noiseless, positively reliable valve that will maintain absolute uniformity of back pressure.

The Foster Piston-Actuated Pump Governor

Piston-Actuated Pump Governor

Controlled wholly by the discharge pressure, noiseless, perfectly governed, fitted with renewable valve clapper seats. Governs the supply of steam to the pump and the fluid supply.

Illustrated, descriptive catalog, describing the above and other Specialties for regulation of steam, air and water pressures, for the asking.

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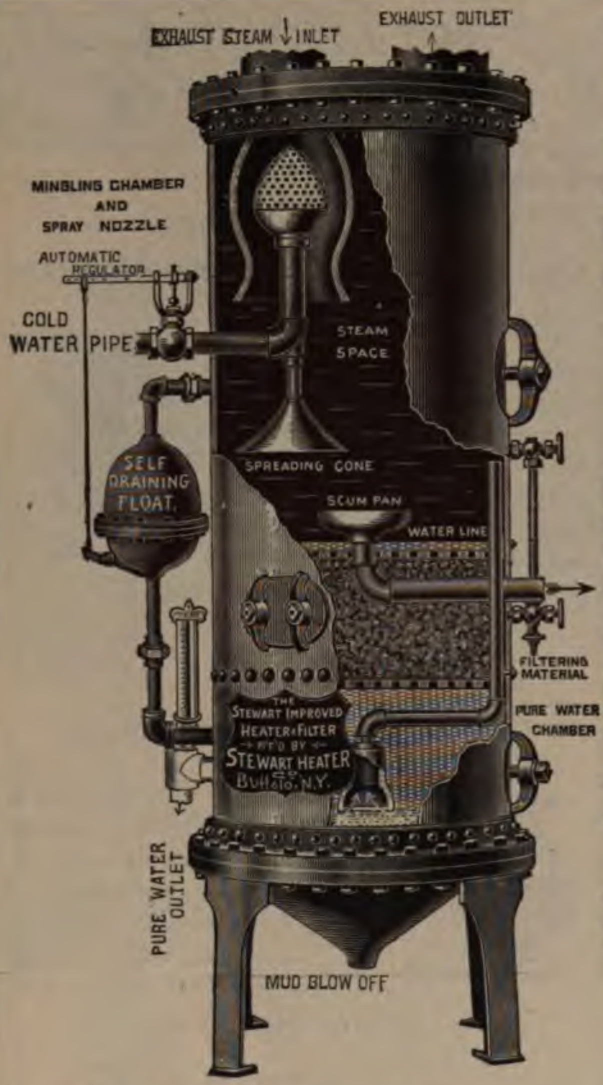

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Improved Feed Water Heate

Oil Separator and Filt

Is guaranteed to increase the economy of your plant

It saves fuel by heating the feedwater
boiling point. Reduces labor of cleaning
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before it goes to the boiler.

It separates oil from the exhaust stea
The exhaust can then be used for other heati
purposes and the condensation returned pu
to the boilers.

It automatically regulates the supply
water to the heater by balanced valve and se
draining float.

Made of the best material and by the be
workmen. Easily installed and cleaned. Se
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That the Power Pump is the most economical form of boiler feed is conceded by all engineers.

It is simple in construction and less liable to get out of order.

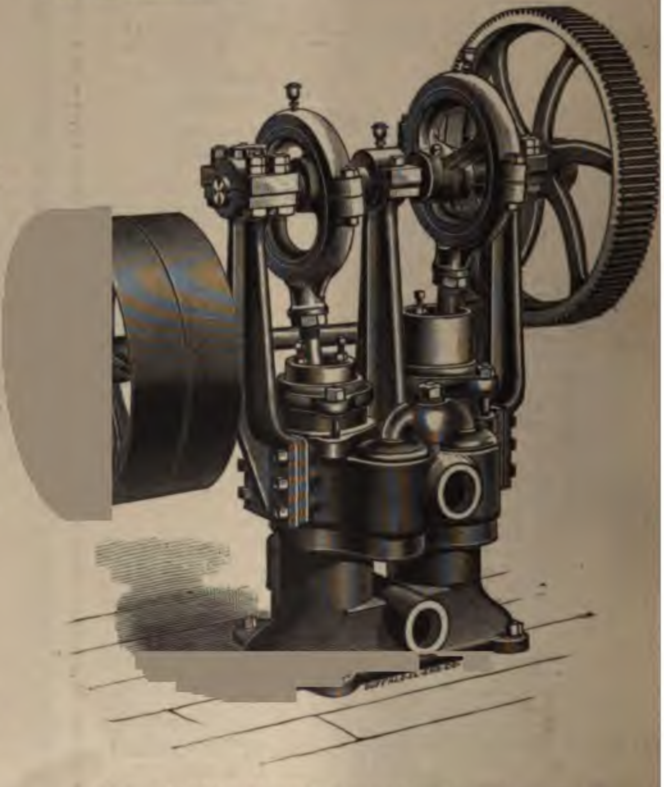
The pump shown herewith is of the double plunger type and can be run as double pump or as two distinct plunger pumps.

It is self contained and complete in itself.

Attach the pipes, put on the belt and it is ready for service.

We make several types.

Get our Catalog.



NO. 6. DOUBLE PLUNGER PUMP WITH ECCENTRICS.

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Save Your Steam

BY USING A

FISHER GOVERNOR

on your Steam Pump. Positive in its action. Prevents an over pressure in the tank or discharge main. For Hydraulic Elevators, Fire, Boiler Feed and any pump where the discharge pressure is to be regulated. If you want to know more about them write.

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IDEAL TWINS

will strain your boiler feed or condenser water thoroughly and economically.

One is always on the job and the other ready to get on when needed.

MERRILL'S SUCTION STRAINER

works in any position; never stops the flow of water; saves building a crib and saves an everlasting lot of trouble and annoyance

It is a duplicate money-making proposition. Steam Turbine users cannot afford to be without it.

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I also make the **Improved Automatic Tic-a-Toc Grease Cup**, the best thing on the market for lubricating crank pins or eccentrics. Send for one on approval.

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LOUISIANA PURCHASE EXPOSITION
AWARDED TO
HARRISON SAFETY BOILER WORKS

Proof

There is a certain manufacturing plant in New England, known all over the world, where one of our

Cochrane Oil Separators

protects a closed heater so that the condensation of the steam used in the heater shall be free from oil and suitable for use in the boilers. When the owners of this plant recently shipped the closed heater to its manufacturers for some necessary repairs, the manufacturers stated that it was the first one of their heaters that they had ever opened without finding marked traces of oil on the steam side of the tubes. It was unconscious and mightly strong evidence that the Cochrane Oil Separators

Take Out Oil

from exhaust steam so thoroughly that this steam when condensed can be safely used as boiler feed or in manufacturing processes requiring pure, hot water.

The closed heater manufacturers were surprised when they learned what kept the oil out, but they probably did not know that there are over 10,000 Cochrane Separators giving just as good service in actual operation.

A Cochrane Oil Separator placed ahead of your closed heater, or in the line leading to your exhaust steam heating system, would save you hundreds or thousands of tons of pure, hot water every year, which would mean an annual saving of many times the cost of the Separator.

What are your conditions? Perhaps we could be of assistance, or perhaps you could find some good point or suggestion in our Separator Catalogue 43-S.

Harrison Safety Boiler Works

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Manufacturers of Cochrane Feed-Water Heaters, Cochrane Steam and Oil Separators, and the Sorge-Cochrane-Systems.

MONITOR DUPLE
STEAM PUMP

Require less attention, fewer repairs and give better satisfaction than any other pump on the market on account of their

Simplicity, Durability and Reliability

THE MONITOR DUPLEX BOILER FEEDER

Diameter of Steam Cylinders	Diameter of Water Pistons	Length of Stroke	Capacity	
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3	2	3	100	2
4½	2¾	4	200	4
5¼	3½	5	350	7
6	4	6	500	10
7	4	8	600	12
7	4½	8	750	16
8	4½	10	900	17
8	5	10	1000	21
10	5	10	1000	21
10	6	10	1500	32

For hot water boiler feeding under high pressure, t MONITOR DUPLEX OUTSIDE CENTER PACKI PUMP, illustrated below, is especially desirable.

All water valves are located above the cylinders, so tl vapors due to hot water do not enter the cylinders, which sures quiet operation. All valves are accessible through ha holes located on top of the valve chambers.

Our prices will be interesting to you

THE MONITOR OUTSIDE CENTER PACKED PUMP

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NATIONAL FEED WATER HEATER

2,000,000 Horse Power in Daily Use.

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Supplies Water to the Boiler at 212° F.

ianufacture the Original and Only Genuine First-Class Coil Feed Water Heaters.

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Catalogue and Prices on application.

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ND PACKING TOOLS

Will go in any valve, rod. pump or engine stuffing box. Will withstand roughest usage.

1 set of 4 Locking Tools.....$1.50
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Constructed so as to embody great Lifting Power with Strength and Capacity. For further information

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We will give you an opportunity to increase your income by using your spare moments. You will be your own boss and we will help you in every way possible. If you have a little spare time each day and want to use it advantageously, write at once.

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QUINCY ENGINES

HORIZONTAL, CORLISS AND VERTICAL, MEDIUM SPEED, AUTOMATIC. 100 TO 3,000 HORSE-POWER.

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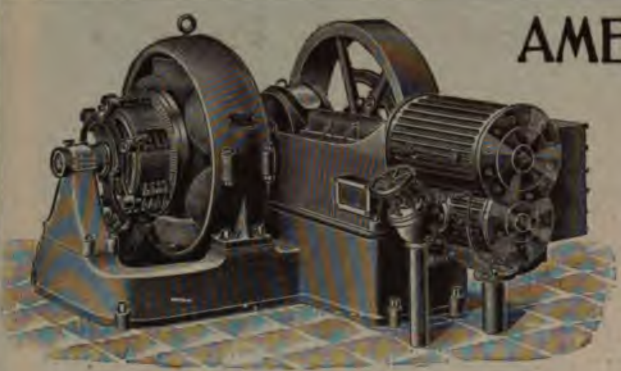

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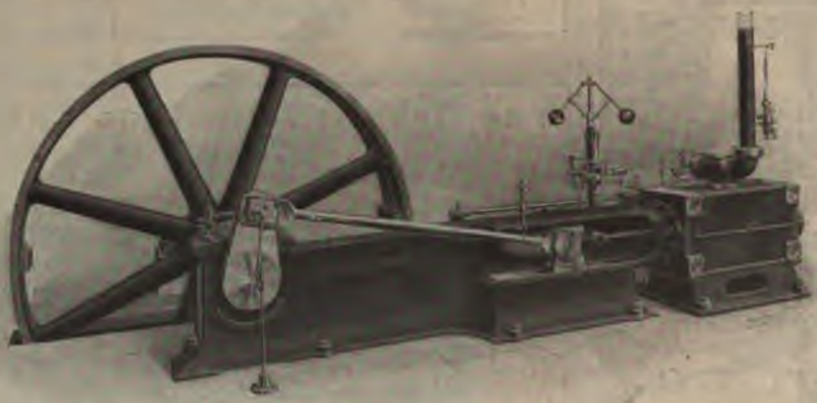

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ENGINEERS' REVIEW

ol. 16
o. 8.

CLEVELAND, OCTOBER, 1905.

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NGINEERS’ REVIEW

FOR STATIONARY ENGINEERS

.6. CLEVELAND. OCTOBER, 1905. No. 8.

ELECTRICAL EQUIPMENT OF THE .L RIVER BRANCH OF THE NEW 'ORK & HARTFORD RAILROAD.

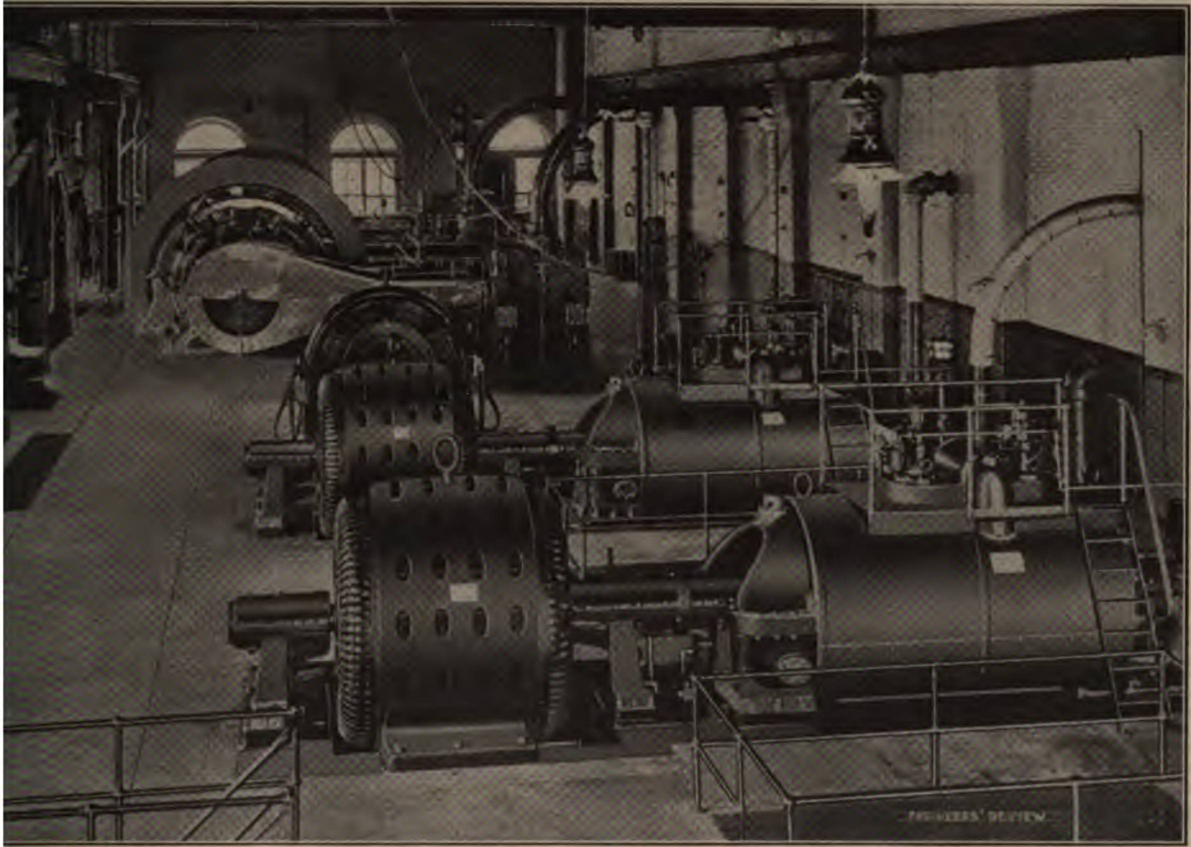
teresting electric equipment has recently been l and installed by Westinghouse, Church, Kerr f New York city, for the Fall River branch of v York, New Haven & Hartford Railroad, perates a double-track road between Provi- id Warren, R. I., with single-track extensions from Warren to Fall River, Mass., and Bristol,

oad has been operated electrically as a direct- nstallation since 1900, the current being gen- the Warren power station at 550 volts. Op- n connection with this station are two storage tations, one at East Providence, R. I., and the Brayton, Mass., which are connected with r station through heavy copper cables.

to increased traffic demands, the old equip- s not adequate to meet the new conditions, ntract was entered into with the above named for additional equipment. After careful con- n of present conditions and possible future requirements, it was decided that an alternating current installation would better meet the requirements than an enlargement of the existing direct current system.

The introduction of an alternating current system in connection with the existing direct current system introduced several interesting problems, chief among which was that of operating the alternating current sub-stations with direct current from the machines in the old station, the generating units in this station being in such good condition as to preclude their abandonment. This was accomplished through the use of an inverted rotary transformer connected between the new alternating current machines and the direct current machines in the old station. The excellent results obtained from this apparatus have fully demonstrated the practicability of this method, for this unit acts automatically in changing alternating current of 13,200 volts to direct current at 550 volts, or *vice versa*, as conditions of service require.

It has also been found that the old station apparatus operating with this converter, with no alternating current machines or storage batteries connected in serv-



NGINE AND TURBINE EQUIPMENT OF THE FALL RIVER BRANCH OF THE NEW YORK & HARTFORD RAILROAD.

ice, will carry the present loads in a much more satisfactory manner than was possible under the old conditions.

The power station building at Warren is a continuation of the old station building, but has been made entirely fireproof. The structure consists practically of two buildings, separated by a partition wall; one housing the boiler equipments, and the other housing the engine and the electrical apparatus. This latter building is arranged with an extension, to provide room for the switchboard, and has also two floors; the upper floor carrying the steam turbines, generating apparatus, switchboard, and superintendent's office; the lower floor carrying the condensing apparatus, transformers, cables, storeroom and attendants' quarters. Fig. 1, is a view of the engine and turbine rooms The general arrangement of the turbines and boilers is shown in Fig. 2.

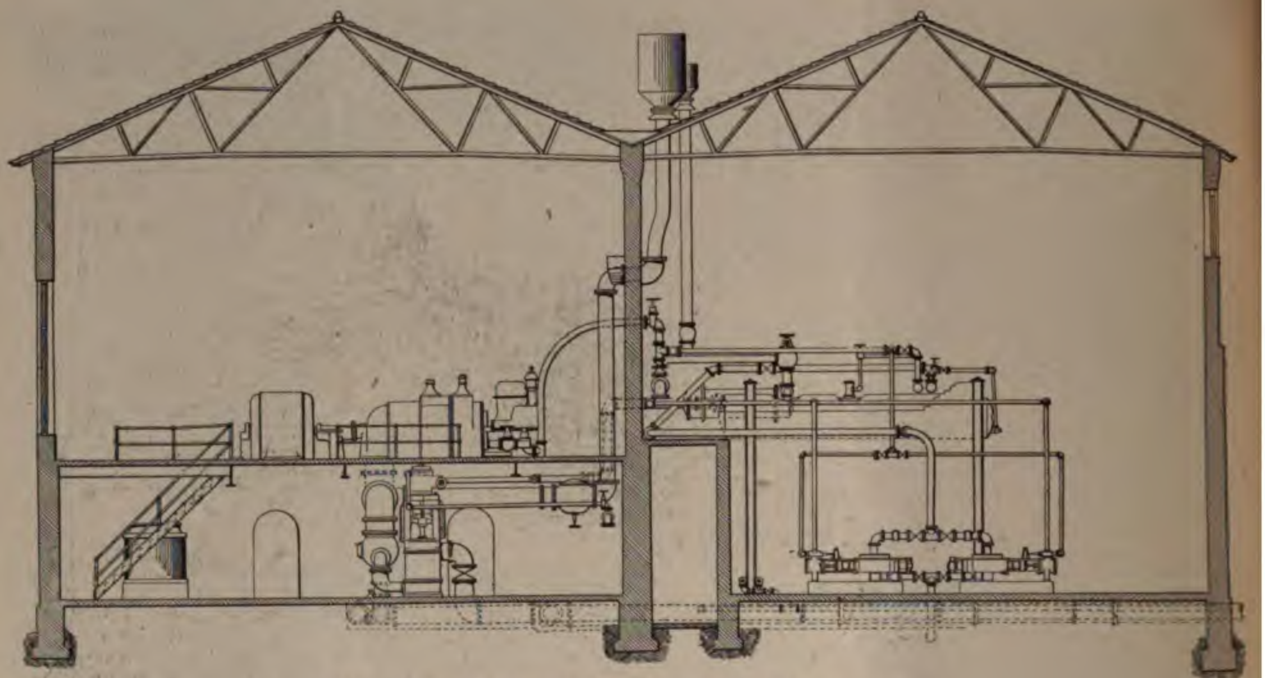


FIG. 2. ELEVATION SHOWING TURBINES AND BOILERS.

The boiler room is one story in height, and contains the boilers, steam pumps, water and steam lines. The floor of this building is laid with vitrified brick, with an ash track running through the firing space in front of the boilers. An elevated coal trestle is located just outside the boiler room wall, which is arranged with inclined bunkers, from which the coal passes directly into the boiler room by gravity.

The roof of the new addition is made of Ludowici tile, carried on steel trusses. The floor of the engine room is made of reinforced concrete, carried on steel floor beams. The floor of the basement is also made of concrete. Heavy steel girders are also carried along the walls of the engine room, forming a runway for a traveling crane.

The boiler room equipment consists of four Babcock & Wilcox water-tube boilers, having a normal rating of 400 horsepower each, arranged in two batteries. These boilers are designed with flat grates, and also for the introduction of superheating apparatus and stokers, should these latter be desired. A brick smoke flue is carried along the rear wall of the boiler room, and is arranged with damper connections into each boiler. On the outside of the building, this smoke flue enters the masonry base of the chimney. This base is 20 feet high, and carries a self-supporting steel stack 9 feet in diameter and 130 feet in height. Fig. 3 shows a plan view of the new power station.

The boiler room also contains two 12 x 7 x 12-inch feed pumps, made by the Warren Steam Pump Co., of Warren, Mass. These are of the duplex outside-packed plunger type, with separate valve chambers. A 4-inch deep well, which is used at times of interruption to the city water system, is also located within this building. This well is piped direct to the feed pumps in both stations, and also to the storage tank which is located outside of the building.

The high-pressure steam lines are arranged in two headers, one furnishing steam to the turbines, and the other supplying steam to the auxiliary apparatus i the station. The boiler connections to the steam hea ers are provided with extra heavy reverse current a tomatic stop valves, which were furnished by the Ne Bedford Boiler & Machine Works. These connection and those from the headers to the various steam a paratus, are carried on direct lines, ample provisi being made for expansion and contraction by mea of suitable bends. The headers and the ends of bran lines are provided with drip chambers and conne with a Holly return system, which conveys the wat of condensation back to the boilers.

The exhaust lines from the turbines pass direct the condensers, which are located along side of the machines, with a by-pass connection to independe atmospheric exhausts, in which lines are connect 16-inch Blake relief valves, of the horizontal patter The exhaust steam from the auxiliary apparatus is co veyed to an 800-horsepower Goubert horizontal i n heater. This connection also leads to a sep- atmospheric exhaust. The water connections the feed pumps to the heater are made up with heavy pipe and fittings, and from the heater to oiler with brass pipe. The water connection at eater is also by-passed, to admit repairs being to the heater without interruption of service.

steam, exhaust, hot water and drip lines through- e station are insulated with magnesia covering. This covering was applied in blocks and wired in place, then covered with insulating paper, and over this a canvas jacket was sewn.

The drips from the exhaust lines are carried to a Nason trap, which discharges the water of condensation into the sewer. The tide water which is used for condensing purposes is taken from a cove adjacent to the power station building. The water is led through a timber sluiceway to a brick suction well, from which

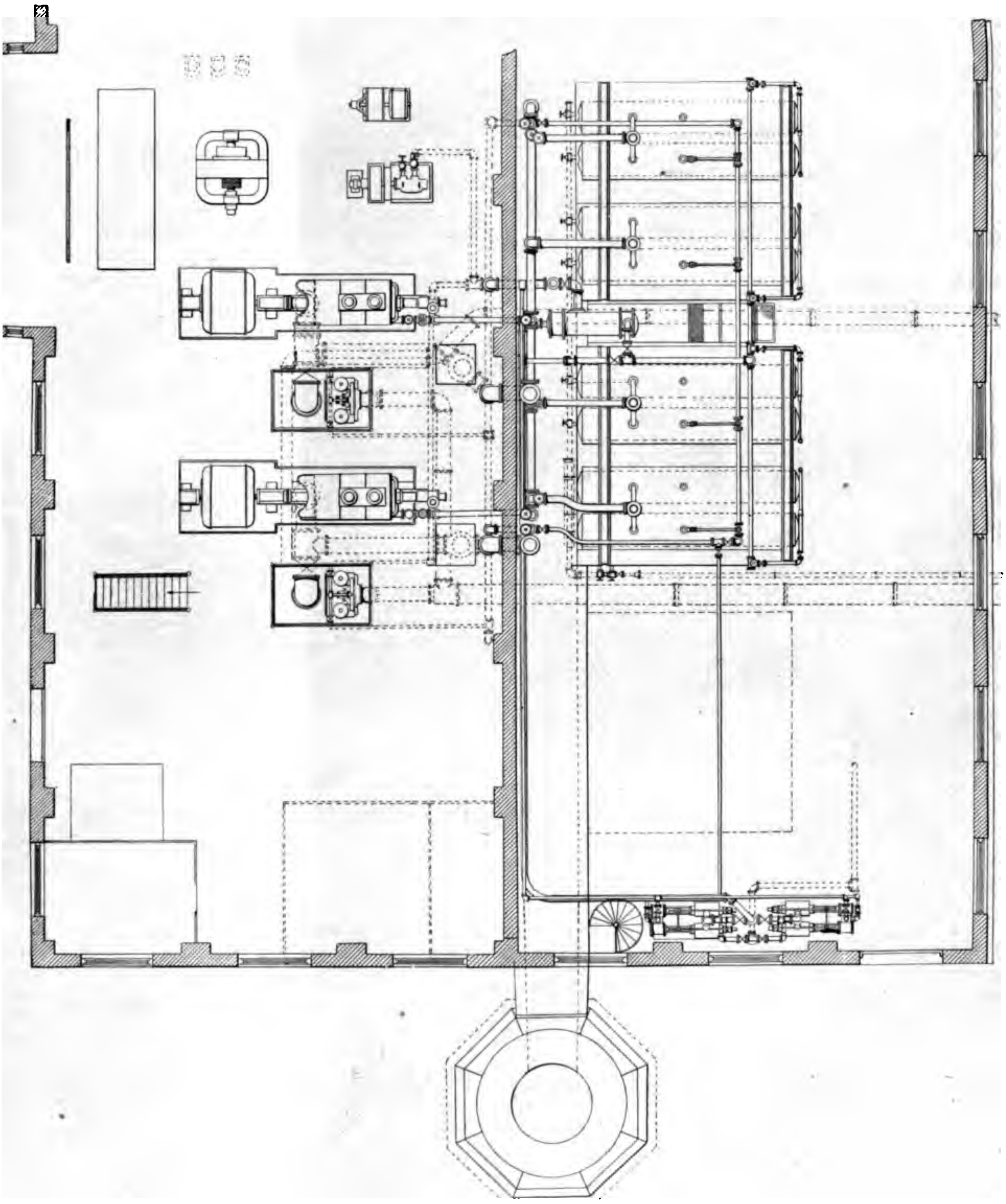


FIG. 8. PLAN VIEW OF THE NEW TURBINE AND BOILER ROOMS.

point the water is carried through cast iron pipes to the condensers.

The engine room equipment consists of two Westinghouse-Parsons steam turbines, direct connected to two 750-kilowatt, 25-cycle, 13,200-volt, revolving-field generators, furnished by the Westinghouse Electric & Mfg. Co., each unit being mounted on a separate cast iron base. These units operate at 1,500 revolutions per minute. The turbines are connected by means of easy bends with the steam main located in the boiler room, and with the vertical twin air pumps and jet condensers located in the basement of the engine room. These machines, when operating on a vacuum of 26 inches, develop an electrical horsepower hour, on 16 pounds of steam. The condensers have a capacity of 15,000 pounds of steam per hour, with a vacuum of 26½ inches. The turbines are also equipped with an independent oil pump and storage tank, to insure a full supply of oil at all times, and to permit the removal and filling of the oil system expeditiously.

The generators are connected to the switchboard with extra heavy rubber-insulated lead-encased cables, supported on steel frames hung from the basement ceiling. To furnish the current for exciting the fields of the generators, a 50-kilowatt direct-current steam-generating set, consisting of a 9-inch Westinghouse compound engine, direct-coupled to a 50-kilowatt, 125-volt, direct-current Westinghouse generator; and a motor-generator set, consisting of a 75-horsepower Westinghouse induction motor, direct-coupled to a 50-horsepower, 125-volt Westinghouse generator, have been provided. These machines also furnish the current for arc and incandescent lighting throughout the building.

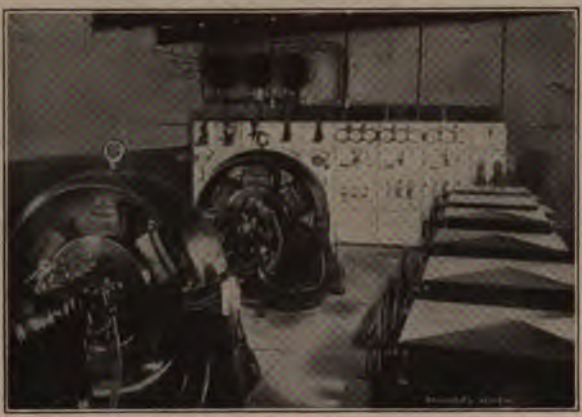


FIG. 4. INTERIOR VIEW OF ONE OF THE SUB-STATIONS.

The switchboard consists of two sections, one carrying all the high tension switching apparatus, and so designed as to carry the various switches in fireproof compartments, the contacts being operated in a bath of oil. The low tension switching apparatus is mounted on a 2-inch marble switchboard, made up of nine standard panels, having the instruments mounted on the face of the board and the wiring carried on the back surface.

A 750-kilowatt inverted rotary, already referred to, is located on the engine room floor. This machine is connected through three 225-kilowatt surface cooled transformers to the high tension bus bars and switches, and through the low tension switchboard to the generators in the old station. This machine is also provided with a separate exciter mounted on the rotary armature shaft, so as to provide a large range of regulation. The high tension lines leaving the station are equipped with choke coils and lightning arresters.

The sub-stations at East Providence, R. I., and Brayton, Mass., each contain three 300-kilowatt rotary converters, nine 110-kilowatt surface cooled transformers, arranged in sets of three, each set serving a single rotary. An interior view is shown in Fig. 4.

The low tension switchboard consists of two feeder panels, three panels for the direct current side of the rotaries, three panels for the alternating current side of the rotaries, and one high tension circuit breaker panel. This latter panel, however, carries only the remote control and trip coils of the breakers, the switches proper and the bus bars being located in fireproof compartments in the rear of the board.

The high tension lines entering the stations are also equipped with choke coils and lightning arresters.

The low tension connections between transformers, switchboards and rotaries are made with paper-insulated lead-encased cable, and all high tension connections are made with extra heavy rubber covered lead encased cable. All cables are carried in tile ducts built in the concrete floors.

A NEW AND EFFECTIVE SYSTEM OF AUTOMATIC LUBRICATION FOR VERTICAL HIGH SPEED ENGINES.

The greatest difference in the various make of engines lies in the technical knowledge employed in the designing and proportioning of the various parts for their respective duties, and the skill exhibited by the mechanics employed in building them. Automatic lubrication of engines has been one of the details very slow in development. The splash system has up to the present time been almost entirely used in lubricating engines, and for vertical double reciprocating engines, it is very unreliable particularly at slow speeds. A new method of lubricating vertical high speed engines and which is something entirely different from many of the usual methods, is shown in the phantom perspective of the type *A* engine manufactured by the American Blower Co., Detroit, Mich.

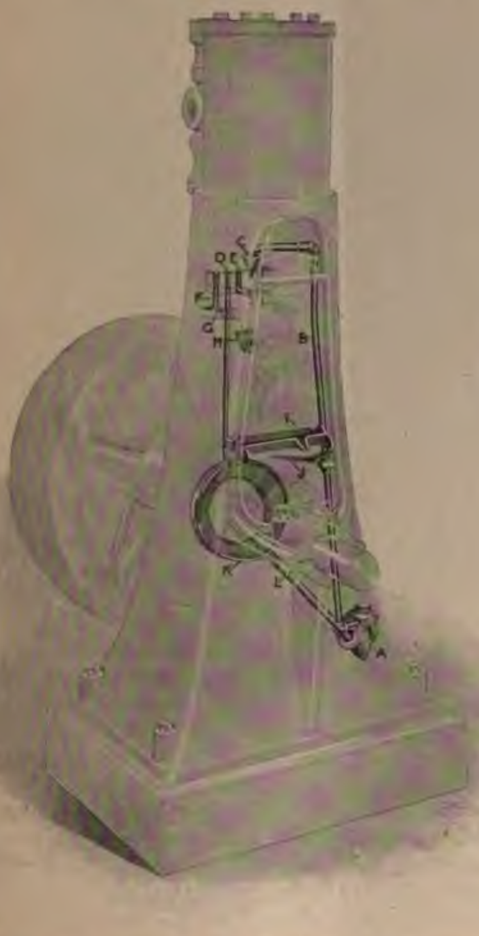
The illustrations show the arrangement of the interior lubricating mechanism. Every frictional surface is running in oil, therefore there can be no possible contact between metals, which almost eliminates all wear.

The phantom outline shows the easy and graceful curves of the engine. The base of the engine is very large assuring freedom from vibration as well as increasing the surface for radiating heat. By referring to the illustration Fig. 1, the operation of the oiling system can be easily traced. The entire area beneath the crank is an oil reservoir, in which the oil is filtered. From this resorvoir the oil is pumped to a point above where oil is required, from whence it is distributed by gravity through 5-16-inch brass tubes to every part needing oil. On the engine shaft is an eccentric *K*. *L* is the air pump, the plunger being held in contact with the eccentric *K* by a spring at the lower edge, working in tension. *A* is a chamber attached to the outside of the frame so as to be easily ssible and in this is located the pump valve. The ger can be removed through the bottom when nec- ry.

he oil is forced up through a ⅛-inch pipe *B*, harging into a brass wire funnel shape strainer *C* which the oil empties into a tray which is cast ne of the panels. From this tray brass tubes lead oil to the various parts of the engine. The upper of the tubes project up nearly level with the top he tray, and have a narrow strip cut down to the om, so oil will run evenly into all the tubes, and her, nothing can lodge in them to clog them up.

he tube *E* oils the crosshead pin through an oil- *H*, which is screwed into the end of the pin. The *F* oils the crosshead guides, a similar tube being he opposite side. The tube *D* oils the crankpin. tube discharges into an oil ring, inside the ec- ric *K*, attached to one side of the crank cheeks. ring has an oil retaining flange along the outer Into the crankpin are drilled diagonal holes as vn at *O*, Fig. 2, which connect to a groove cut in face of the pin. The rotation of the crank pro- s the centrifugal force to drive the oil through e channels, there being a fresh stream of oil at y revolution and just ahead of the time when the test pressure is on the pin.

addition to this independent supply, the ring also es the drip from one end of the main bearing.



IG. 1. TYPE A ENGINE. PHANTOM PERSPECTIVE.

The oil that drips from the crosshead is caught in two oil pans as shown at *I*, Figs 1 and 2. These pans are attached to the inside of the enclosing plates. From the pans the oil drips into the pockets *J* and runs down the inside of the plate, dropping into cups set in the tops of each of the main bearing caps.

Instead of the usual oil grooves in the top and bottom of each of the main bearings, in this system the oil is supplied at the sides where the bearing is cut away at the joint. When the strain from the connecting-rod is up, the oil is carried to the top of the bearing, but when the strain is reversed, there are no oil grooves to carry away the oil. On the eccentric side, the oil running out at the end of the bearing is caught by the eccentric, oiling the eccentric strap through the groove *N*, after which it drops into a case enclosing the eccentric, returning to the oil chamber at the base of the engine through a channel cored into the frame as shown in Fig. 2.

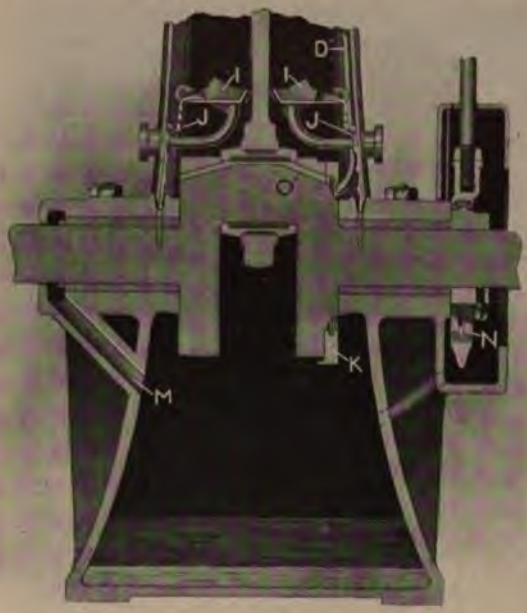


FIG. 2. SHOWING METHOD OF OILING CRANKPIN, JOURNAL BOXES AND ECCENTRIC.

On the opposite side the oil is thrown into a similar channel *M*, by a ring on the shaft.

The governor pin on the automatic engine is oiled from the eccentric before the oil is returned from the base of the engine. The oil after making a complete circuit is strained, and filtered by a very simple, but effective means in the engine base.

With this system of oiling a most copious stream of oil is supplied, being about ¼-inch in diameter, none escaping to the outside and the engine is perfectly clean and dry. This is a system which will appeal to the experienced engineer as a practical and effectual method of oiling and should do away with all difficulties arising from insufficient lubrication which is the main source of most engine troubles.

Steam rising from water at its boiling point (212 degrees) has a pressure equal to the atmosphere (14.7 pounds to the square inch.)

THE LARGEST WATER TURBINE AND ELECTRIC MOTOR IN THE WORLD.

The industrial progress of many of the largest cities in Canada is so intimately associated with the development of her many waterfalls, so richly latent in energy, that the mere mention of the former will suggest the latter. In spite of the fact that the application of these waterways to useful purposes has been attended in many cases by a very large expense, the cheap power obtained has proven a splendid investment as the universal success of these power plants attests.

An interesting one of these plants is that of the Shawinigan Water & Power Co., which utilizes the power of Shawinigan Falls situated on the St. Maurice River.

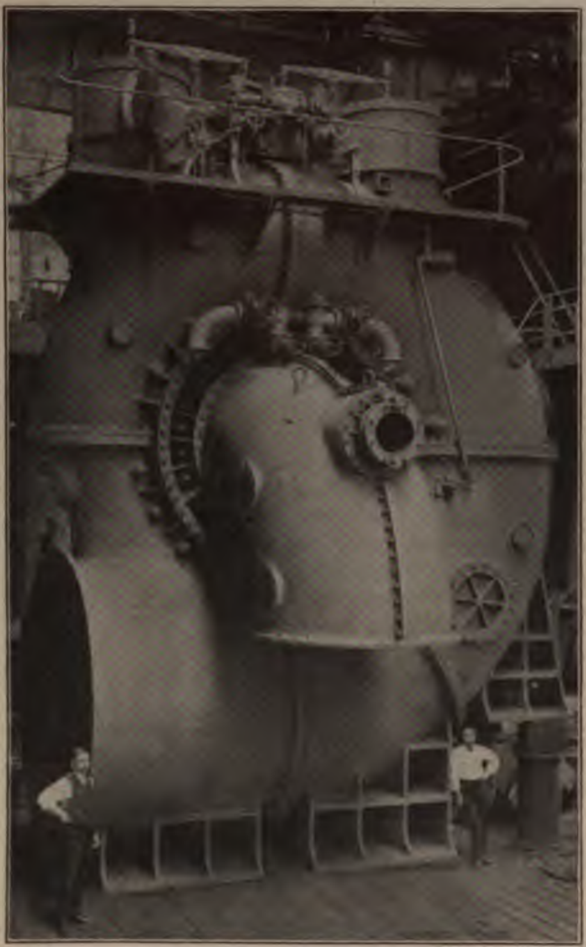


FIG. 1. 10,500 HORSEPOWER WATER TURBINE, THE LARGEST IN THE WORLD.

The bend in the river brings the upper and lower water levels within a short distance of each other, thus inviting the location of a power house at the bottom of the slope between them. From the south end of the upper lake or forebay, a canal 20 feet deep and 1,000 feet long leads to a point where the ground begins to fall through a vertical height of 140 feet in a horizontal distance of 500 feet. Here the canal is closed by a concrete wall, which is pierced by six outlets for as many penstocks, each 9 feet in diameter. Provision is made for such further extension of the wall and addition of the penstocks as future developments may call for. At present four penstocks are in pos carrying water to as many turbine wheels in the p house on the shore of the lower lake. Three stocks supply three 6,000-horsepower, horizontal- turbines, direct-connected to three 3,750-kilowat volving-field generators, giving a quarter-phase volt 30-cycle current. The wheels run at 180 re tions per minute, and provision is made for a 2 cent loss in the generators and a 15 per cent ove

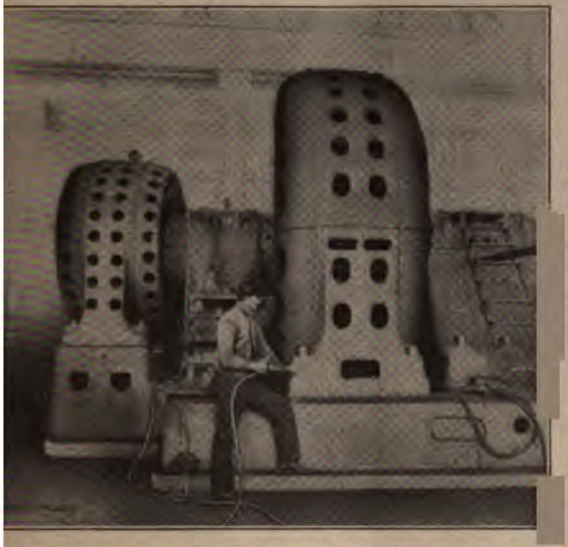
The fourth penstock supplies a fourth turbin cently installed by the I. P. Morris Co., of adelphia. This turbine is the largest which has been constructed. It has a capacity of 10,500 power, and a good idea of its huge dimensions obtained from the illustration, Fig. 1. It is horizontal-shaft, inflow type, with spiral casing a draft tube on each side, through which the discharges outward from the center. The water the turbine through the intake, 10½ feet in dia at the bottom of the turbine. It flows around an the outer spiral tube, and then passes in ra through an annular set of distributor vanes through the wheel, and, diverging, finally disch right and left through two large draft bends, o either side, one of which is shown in Fig. 1. In bends are situated the stuffingboxes for the shaf of which is clearly visible in the view shown. bearings are situated on separate pedestals (se from the turbine proper) but are not shown photograph. It will be noticed that although t ameter of the intake is 10½ feet at the bottom sectional area gradually diminishes as the water around the tube, the diminution being proportion the amount of water that flows in through the as its circumference is traversed.

The dimensions of this vast machine are as in sive as the photograph. It is 30 feet from base t 22 feet wide over all, and 27 feet from center t ter of the two shaft bearings. Its total weig 364,000 pounds. The shaft, which is of forged is solid and weighs 10 tons. It is 32 feet 3½ long, 22 inches in diameter at the center, and to 16 inches on the generator side and 10 inches d ter on the other side. The runner or wheel, wh the rotating part of the turbine, is of bronze weighs 5 tons. The quantity of water used whe turbine is operating under full load is enormou less than 400,000 gallons passing through per m Just what this figure amounts to, will be under when we state that it represents a river 100 feet 9 feet deep, and flowing at the rate of 60 fee minute. In spite of its size, this huge machine was in less than five months, the contract being s May 19, 1904, and the photograph taken Octo of the same year.

The present output of power from the Shawi station is 18,000 horsepower, and of this about horsepower is transmitted 84 miles over long-dis lines to the city of Montreal, where it is use street railway, electric lighting, and general purposes. The remainder is taken by local user similar purposes and for electrolytic processes. current is stepped up at Shawinigan from 2,20 quarter-phase to 50,000-volt three-phase. The horsepower turbine increases the capacity of th tion to 28,500 horsepower. Two of the 6,000- power turbines were also built by the I. P. Morri the third by Esher Wyss & Co., of Switzerland.

ie current is generated at 2,200 volts, 30 cycles
transmitted to Montreal over aluminum cables,
voltage being stepped up to 50,000, and as the
act of the Shawinigan Co. called for de-
y of power in Montreal at 60 cycles it was more
enient to transmit it at 30 cycles, so it was decided
iange the frequency at Montreal by synchronous
r generator sets.

r this purpose the Shawinigan Co. have erected
ge terminal station at Montreal in which at pres-
are installed five 1,200-horsepower, one 8,000-
power frequency changers and two 900-horse-
r three-phase transformers. In addition to this
ratus there are also two 800-kilowatt rotary con-
rs which supply direct current to the street rail-
company. All of these machines, including the



HORSEPOWER SYNCHRONIZING MOTOR. THE LARGEST IN THE WORLD.

ng apparatus, were built and installed by The
ck Electric Mfg. Co., which is now owned by the
Chamers Co.

e 8,000-horsepower synchronous motor generator
s undoubtedly a unique piece of apparatus. It
sts of a 5,750-kilowatt alternating current gene-
, an 8,000-horsepower synchronous motor and a
t connected induction motor for starting pur-
, all mounted on the same base. The motor is
le of developing a maximum starting torque
alent to 2,500 horsepower. This set is not only
argest frequency changer ever built, but it is
osed of the largest alternating current generator
eration at the present time and the largest electric
r ever built. The total weight of this set is al-
500,000 pounds. The transformers were so de-
d that they may, if desired, be operated at 56,000
pressure.

A Useful Cement.

e proportions are: Fine iron filings, 10 parts;
ide of lime, three parts; water, enough to mix
paste. The joints are to be bolted together
the mixture is placed between them, and left
ight.

EXPERIENCES ON THE ROAD.

The following incidents are taken from an article by B. C. Shipman, which appeared in *The Electric Journal.*

A particular generator was a 1.5 kilowatt of a prehistoric period, but for all that, doing yeoman service in an antiquated plant, which at one time had produced all the carborundum made. It was used as an exciter to an alternator and had never given any trouble until a short time before when it burnt out and was rewound at the factory. After its rewinding it was impossible to hold up the voltage on the alternator, no voltmeter or other instrument being in the circuit of the exciter. A thorough examination of the exciter and its circuit failed to reveal any cause for its not delivering proper voltage to the alternator, except that it sparked slightly. In endeavoring to remove the sparking, a really surprising result was discovered. Rocking the brushes backward raised the voltage and took the spark away.

Of course the natural conclusion was that the throw of leads had been made wrong in the rewinding, but on cutting off the canvas head such was not found to be the case at all. The leads were absolutely correct, and as they were before rewinding. Repeated trials showed conclusively that the brushes should be set back far beyond their proper position, which was fixed to a certain extent by the design of the machine, and it was impossible to get the brushes back as far as they should go. As the machine had to be in operation that night, and as I did not particularly like that part of the country as a residence for a longer period than absolutely necessary, it was a "rush" job of disconnecting all the leads of the commutator to see if any coils were wrongly connected. When the last lead came from its commutator bar, the cause of the trouble was disclosed. The commutator was loose on the shaft, being of a type held in place by a cup setscrew and no key; and the drag of the brushes was sufficient to rotate it around the shaft through quite an arc, although when the machine was standing still the spring of the leads would pull it back into place. The last lead was soldered back just in time to catch the seven o'clock train for town.

An equally simple thing, but which was threatening much more serious consequences, was the case of an 800-kilowatt, 550-volt, direct-current, engine-type railway generator. This machine had been installed for a couple of years, and had been very unsatisfactory, indisputably so, since its commutator had to be turned very regularly once a month during that time. Nothing seemed to do it any good, except turning, and even that was only a palliative. Considerable time and effort had been spent in re-designing it, so to speak, that is, putting extra balancing rings on the back of the armature, and chipping the pole faces. As far as saving the commutator went, the power house records showed that these efforts went for naught. The symptoms in the case were as follows: After turning, the generator would start off beautifully, taking all kinds of load from 25 to 175 per cent, without showing a sign of it; pretty good proof that it was electrically all right. After a few days of this angelic operation a small spark would begin under the brushes and day after day would get worse until at the end of three weeks or a month, if allowed to continue so long, the fire thrown from under each brush would be 4 or

5 inches long in times of heavy load, sometimes flashing the machine. The first view I had of the machine was in its quiescent state. It had just been turned the day before. The power house attendants assured me that every attention was given the machine, every kind of commutator lubricant and all ranges of brush tension had been tried, with absolutely no appreciable improvement in its operation. This, by the way, illustrates the fallibility of human testimony.

The brushes were found to have a tension of about 9 to 11 pounds each. The only remedy applied was the reduction of this tension to 2 or 2½ pounds. The machine has never since given trouble.

To show what can be done to prevent shutdowns, and also to illustrate the hardiness of electrical apparatus, I may cite the case of a 5-horsepower, 500-volt, type *M* motor which was a very important part of an equipment in which it drove a set of reversible clutches, a water pump, an air pump and lowering and raising mechanism. This complete apparatus worked 22 hours out of the 24, and a shutdown of the motor put a $30,000 plant out of business with a loss of income of $264 a day. It was of course very poor policy not to have extra parts or even a whole motor on hand, but such was the case. Duplicate parts were ordered soon thereafter. Owing to the clutches sometimes sticking, the motor would flash and the arc flare up against the field coils. A very few of these arcs would burn through the taping of the field coils into the winding, and thus cause an open field. We repaired this motor several times, and the repair did not take more than three minutes by the clock, as it consisted only in bunching all the ends of the wires of the field winding we could see, and twisting them together to complete the field circuit. The amount of field winding gradually cut out of circuit by repeated repairs of this nature, did not seem to affect the operation of the motor in the slightest degree, and no ill effects could be observed.

Another curious phenomenon which I have incidentally ran across in several cases is the peculiar blackening of commutators. The only machines in which I have observed it have been four-pole with wave-wound armatures, though I believe it is quite as characteristic of any number of poles. In four-pole machines, blackening develops first at points diametrically opposite on the commutator and gradually spreads in one direction—against the direction of rotation—until the curious spectacle is shown of one-quarter of the commutator black, the next quarter bright and perfect, the next quarter black and the fourth like the second. The starting line of the blackening is very sharply defined, the latter end not so much so, and if the action is allowed to continue the whole commutator will eventually get black. With a six-pole machine three equidistant points on the commutator show up, and in any case the number of points is equal to the number of pairs of poles. The cause of the trouble is in unequal spacing of the pole pieces, and the remedy lies in chipping them until the pole faces and pole spacing are equal.

A very curious spectacle and one not very soothing to a nervous temperament was presented in an installation I lately completed. We are all familiar with pumping or hunting of alternators and synchronous motors, but this experience of pumping between direct-current shunt generators has certainly been unique with me. The equipment consisted of four 1,250-horsepower, 300-volt, shunt generators, direct connected to water wheels. There were two generators to a wheel, one on either end. The plant was started under short notice and the brushes of the swivel type were not ground in; consequently they sparked more or less, so that the exact neutral point was difficult if not impossible to get, for there was no cutting off the load to determine it.

Late one night a small "Canuck" appeared at my house as I was preparing for bed excitedly repeating, "O M'sieur, M'sieur! Dey want you at de 'batisse' quick, quick, quick!" The inhabitants always refer to a power house as "batisse electrique," and usually drop the "electrique." When finally I summoned enough French and English combined to inquire what the matter was, he almost shouted "De big w'eel's all fire, fire, fire!" Another idiosyncrasy of the inhabitant is to express the superlative degree by a triple repetition. A lantern and a pair of rubber boots were quickly obtained for the mile long muddy walk, but when I arrived at the power house all the machines were shut down, and the operating force in a flurry. The only description I could get of the trouble was that the machines for no apparent reason suddenly began to throw fire, first one and then another alternately, and the operator said he thought the two machines on one wheel were behaving this way. I ought to explain here that as this plant runs on practically a steady load night and day, no governors were installed, hand regulation only being used. Also because no speed indicators were installed it seemed possible that, owing to widely different speeds on the units, and hence different field excitations, a slight change of load might have upset an unstable condition of multiple operation, but in this event the trouble would have to appear between machines of different water wheels and not between those on the same wheel. We immediately started the plant again to verify this point. It went off very well, no trouble being experienced in putting the machines in multiple. I had about come to the conclusion that the operator must have had a "pipe dream," when suddenly one machine groaned, gave a slight spit, and then another machine groaned a little louder, and the noise passed back again to the first, the fire under the brushes getting a little more vicious at each instant. For a few moments it was impossible to discover which machines were showing the trouble, as all the ammeters were disturbed, and before we could definitely decide No. 2 unit had been cut free from the 'busses and the cylinder gate throttled. By this time it was evident where the trouble was. No. 1 unit was in full exhibition.

A generator would groan and throw a sheet of fire from under its brushes while *B* would be quiet. This condition would last for about two seconds, then the machines would exchange conditions. With each swing the ammeters would reverse. There was no question about it, first one machine would be a generator and the other a motor, and then *vice versa:* both of them on the same shaft.

The cause of the trouble, which fortunately was very quickly found, arose from the fact that the brushes were not placed in similar commutative positions on the two machines. Whatever the position of the brushes, it did not make any difference so long as the load remained steady, a perfect adjustment could be had by the field rheostat, but any considerable change of output upset the condition of equality of potential difference between the machines, and so the one delivering the lowest voltage would become a motor while the other would remain a generator. But this action itself would immediately cause a readjustment of voltages, the generator dropping below the motor, and of course the action would immediately reverse, *ad infinitum* and cumulatively. The cause once known the remedy was easily applied, and the machines were back in service within a few hours.

A point which I do not think the average engineer appreciates is the length of time it takes to dry out transformers under certain conditions. Of course the ideal way is to heat the transformer in a vacuum, finally admitting the oil before destroying the vacuum. This is also the quickest way, but it is seldom that any facilities are found so that advantage can be taken of this method. Then recourse must be had to heating either by current in the coils of the transformer itself, or by heat generated externally. The former is the only one of the two worth considering if one has a choice. The usual assumption that a few days of drying at a temperature of about 90 degrees C. fits a transformer for use, while applicable perhaps to the majority of cases, is not reliable in the case of high voltage transformers. I had one high voltage transformer that had to be kept at the above temperature for two months and a half before being thoroughly dry, and out of 14 others that had not been as carefully protected as they might have been before erection, five of them went over two months before the insulation resistance was high enough to be considered satisfactory. The method of testing the insulation resistance, with a high resistance voltmeter using as high a voltage as possible, has with me always given unfailing indications of the condition of the transformer.

As a last but not least experience of interest and use to roadmen, I will mention a remarkable case of resuscitation accomplished on a man who received about 12,000 volts. We were running a load test on the transformers of this plant, and the bare high tension wires were led directly from the transformers out of the windows and to plates dipping in the river. The voltage was 25,000 and the arrangement two-phase, all four plates being in the river at the same time. In corroborating the fact that the man received 12,000 volts, experiment developed that practically the whole resistance of this natural water rheostat lay in the contact resistance between the plate and the water, and not in the distance of the path between the plates. A distance of 40 feet between plates produced no measurably different load than a distance of 20 feet, with equal amounts of submersion. Hence the whole body of water and earth adjacent was practically at a midway potential between the two wires. The workman, in direct violation of orders, stepped upon a brick and concrete platform immediately over the water where the plates were hung and his head came in contact with one of the wires. In falling he broke from the top of his head an arc about 18 inches long. His head was burned completely to the bone, as were also his feet, though slightly. By vigorous working he was brought around in three-quarters of an hour, and after dressing went fishing the next day. Without doubt he must have had a cast iron constitution, but it shows what is possible in case of electric shock.

In the running of this test a great number of dead fish floated up to the surface from between the rheostat plates, and the peculiar fact was noted that many of them were distorted, being bent somewhat at right angles in the middle of the body. An explanation of this condition of the fish was sought by the operators, who gathered them in, from the assembled electrical sharps. All passed it up until our erstwhile chief of the transformer division opined that it gave a beautiful illustration of the quarter-phase current, as the fish were killed in a two-phase rheostat.

CONVENTION OF THE I. U. S. E.

The International Union of Steam Engineers held its ninth annual convention at Toronto, Canada, from Sept. 11 to 15.

After the addresses of welcome were over the business began, with the reports of the committees on credentials, laws and resolutions.

The annual address of the president was then delivered by President J. E. Brunner.

The reports of the president and secretary show that the union has grown steadily and that the past year has been the most prosperous in its history. It has been comparatively free from strikes or lockouts in any of its departments. The movement started to bring about an 8-hour day has, it was stated, not met with a single failure.

The secretary reported that 31 new charters for local unions and one state union had been issued; also that three old charters had been reinstated.

The convention discussed an increase in the per capita tax, also the advisability of maintaining an out-of-work fund, a funeral fund and sick fund which had been suggested by Secretary McKee. A special committee which was appointed to consider the suggestion reported in favor of a sick and funeral fund. The committee thought the out-of-work fund unnecessary at this time.

The entertainment committee of the International Exhibitors' Association kept the delegates busy and in a happy mood when their minds were not taken up with the business of the convention.

The new officers of the union are: President, Matt Comerford, St. Paul; first vice president, Arthur McCracken, Chicago; second vice president, James Bannan, Toronto; third vice president, Bill Skiffington, New York; fourth vice president, J. W. Woods, St. Louis; fifth vice president, ————, Boston. General secretary and treasurer R. A. McKee, Peoria, Ill., was re-elected.

The next convention will be held at Milwaukee, Wis.

Following are a few of the American firms exhibiting goods at the convention:

Babcock & Wilcox Co., New York; Crandall Packing Co., Palmyra, N. Y.; Dearborn Drug & Chemical Works, Chicago; Engineer, Chicago; Fairbanks Co., through their Canadian department; Greene, Tweed & Co., New York; International Correspondence Schools, Scranton, Pa.; Jenkins Bros., New York; Lagonda Mfg. Co., Springfield, O.; Lunkenheimer Co., Cincinnati; McLeod & Henry Co., Troy, N. Y.; Peerless Rubber Mfg. Co., New York; Power, New York.

REPRESENTATIVE MEN FROM THE ENGINE ROOM, 26th—B. F. Miller.

Mr. B. F. Miller was born in the town of Ithaca, Mich. His father died when he was six years old and at the age of 14 he was employed, during the summer, as engineer in a furniture factory with a salary of $1.50 per week and board. During the winter he attended the public school. Later on he was offered a position as engineer with the Ithaca flour mill, where he stayed for two years. At this time Mr. Miller began to study the principles of engineering with the help of text books and engineering papers.

His mother later on remarrying, he felt that he could then devote his earnings to his own benefit and therefore decided to learn the machinist's trade, which he did. For the next five years Mr. Miller filled in the time working in the country during the summer and teaching a district school in winter, where he managed to save enough money to pay his way through Eastman's National Business College, Poughkeepsie, N. Y., graduating in the spring of 1887.

B. F. MILLER.

He then returned home and secured a position with the Phœnix Iron Works, Port Huron, Mich., where he remained for three years, obtaining considerable practical knowledge in engineering. While there he received his first U. S. marine license. One year later he accepted a position with the Bery County Electric Co., of Bay City, Mich. Tiring of electric lighting, he was next employed as marine engineer on the Great Lakes on different steamers, ending his career as a marine engineer on the 3,000-horsepower steamer Christopher Columbus, in 1896.

His next position was as chief engineer with the Wallace Kirk Soap Co., of Chicago, leaving them to go to the American Terra Cotta Co., of Terra Cotta, Ill., as chief engineer of their plant, remaining with them for 3½ years. He then returned to Chicago and joined the staff of the Chicago Veneer Co., as chief engineer. When he severed his connections with this firm he went to the Paepcke-Leicht Lumber Co., of Chicago, the largest box manufacturers in the United States. He is still in their employ. Mr. Miller is a graduate of the American School of Correspondence, at Armour Institute, Chicago, Ill. He has also passed the Chicago civil service examination.

Flywheel Explosion.

On September 27, the two flywheels on a 14 x 16, 75-horsepower engine burst, causing considerable damage and tying up the plant for several days. The engine was located in the power plant of the Ohio Provision Co., Cleveland, Ohio. The first wheel to break was the small one which was running free. This was immediately followed by the large wheel which was belted to shafting for running different machines throughout the plant. At the time of the explosion the chief engineer, Otto Schilke, was in the boiler room which opens directly into the engine room. He heard a peculiar noise and started toward the engine. He noticed that it was racing and reached for the throttle when the small wheel burst, the parts flying in several different directions. One narrowly missed him. He then started for the boiler room intending to shut the steam off from the top of the boiler when the large wheel burst. Parts of the wheel flew through the top and sides of the building and landed several blocks away. The eccentric strap then broke, allowing the valve stem to push through the steam chest. He shut off the steam as quickly as possible.

The accident was caused either by the breaking of the governor belt or the pulley on the governor was loose. He is not sure which.

The Ohio Provision Co. immediately wired the manufacturers of the engine and a new governor, together with flywheels, etc., to take the place of the broken parts, were shipped at once and the engine was ready for operation on the third day after the accident.

Flywheel Goes to Pieces.

The 22-ton flywheel on one of the Corliss engines at the Cuyahoga Falls, Ohio, power house of the Northern Ohio Traction & Light Co., exploded late on the night of Sept. 30, 1905, tearing out portions of the walls of the buildings making great holes through the roof. Pieces of iron weighing 1 or 2 tons were thrown hundreds of feet, and spoke of the immense wheel landed 200 yards away, and was forced through a walk into the ground.

A piece of steel weighing 500 pounds fell through the roof of the car barn, broke off a rail of the track, and passed through a cement floor and imbedded itself into the ground a foot. Another larger piece passed over the car barns and buried itself in a potato patch.

Oscar Underwood, the engineer, was thrown across the engine room, but escaped injury, as did the oiler and two firemen in the engine and boiler rooms, although piles of brick fell near them. One of the firemen was struck by a brick.

The engine is of 300 horsepower and gained an excessive speed on account of the governor not working, it is thought. As soon as repairs were made two other engines in the plant were started up.

THE IDEA·EXCHANGE

Readers are cordially requested to contribute to this department. We pay for all letters used. Write as you would to a friend, or as you would talk. Correct spelling and perfect grammar are unnecessary. Interesting experiences, new kinks and ways of doing work, comment on other letters and articles on subjects pertaining to the production, transmission and use of power are acceptible. Illustrations add to the value of descriptive articles. Plain pencil sketches are sufficient. Each sheet should bear the names of the article and the author. We want to hear from YOU.

Valve Motion.

Editor of the Engineers' Review:

Wishing to know the difference in the relation of the valve travel to the piston travel between no load and full load, on a 10 x 14-inch Russell automatic engine, I made a valve motion indicator, and was surprised at the number of things I learned from it. I made a light sheet iron pedestal *A*, Fig. 1, and removing the name plate on the upper guide, fastened the pedestal in its place, with the same screws. The pedestal was shaped to hold a card frame and allow it to move horizontally, receiving its motion from a hook engaging with a pin on the arm of a common indicator pendulum, thus reducing the motion to 3½ inches. The pencil was carried by a stiff wire connected at its lower end with the end of the arm attached to the rocker shaft, and of such length as to allow the pencil to rest in the middle of the card when the valve stem was at mid stroke.

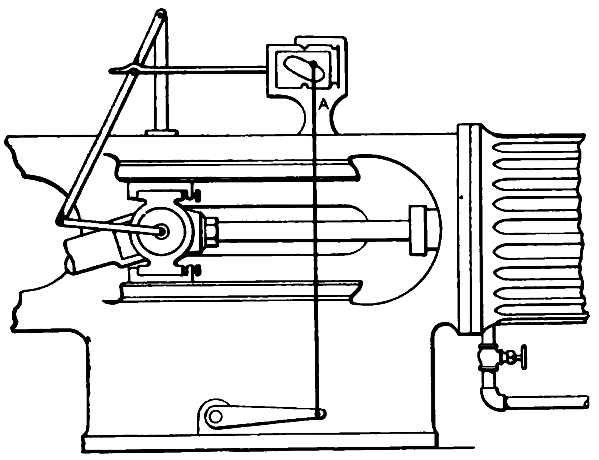


FIG. 1. VALVE MOTION INDICATOR ATTACHED TO AN ENGINE.

If the valve travel were just 3½ inches and the eccentric just 90 degrees ahead of the crank, the pencil would describe a perfect circle, but as the valve stroke gets shorter, the circle takes the form of an ellipse, with the greater diameter lying on a horizontal line. If the eccentric is moved farther ahead of the crank, the ellipse will be on a slant, and the more lead given the eccentric, the greater will be the slant, until the eccentric is opposite the crank or 180 degrees.

The vertical dimension of the diagram represents the stroke of the valve, which is controlled by the governor. The horizontal dimension represents the stroke of the piston and does not vary. The stroke of the piston is reduced for the same reason that it is reduced for an indicator; to make the diagram smaller and more graphic. It is easily seen that if the stroke of the valve and the stroke of the piston began at the same time, the pencil would start from one corner of the card and trace a practically straight line diagonally to the opposite corner.

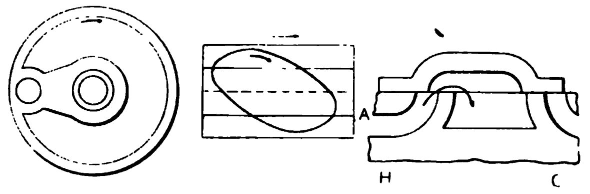


FIG. 2. RELATIVE POSITION OF CRANK, CARD AND VALVE AT THE BEGINNING OF THE STROKE.

The vertical distance that each end of the line reaches from a horizontal line drawn through the center of the card, is the distance the valve travels past the center of its stroke. It is obvious that the eccentric must be in advance of the crank, so that the valve may have traveled more than ½ its stroke before the piston starts to move, in order to give the desired port opening, but as soon as the eccentric is set ahead of the crank, the pencil and card no longer start to move at the same time, and the straight diagonal line becomes a diagonal ellipse.

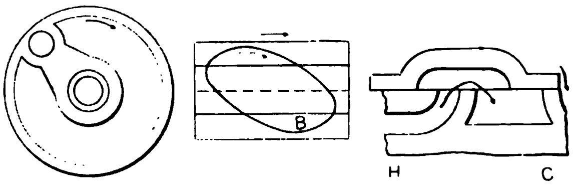


FIG. 3. WHEN THE VALVE IS AT THE END OF ITS TRAVEL.

For instance, suppose the crank to be on the forward center and about to make an in stroke, (engine running under). The pencil, representing the center of the valve will be about at *A*, Fig. 2; the vertical distance of *A*, from the center line of the card, shown by the dotted lines, is the distance the valve has moved past its center of travel to give the desired lead. *H* and *C* represent the head and crank end of the engine. As the piston moves backward, or in, the pencil moves

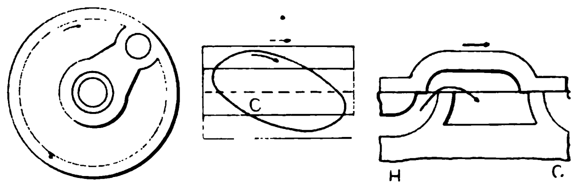


FIG. 4. WHEN THE VALVE HAS CLOSED THE PORT.

down on the card and the valve moves toward the head end of the cylinder increasing the port opening. until at *B,* Fig. 3, where the valve is at the end of its travel.

The pencil will then begin to move upward, the card still moving to the right or backward. When the valve is closing, and at *C*, Fig. 4, the piston has made about ¾-stroke and the valve has closed the port. The forward stroke is just the same only the pencil goes back on the top side of the card. The pencil will move in the same direction whether the engine is running over or under.

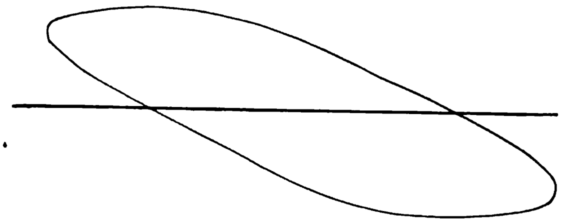


FIG. 5. CARD TAKEN WITH THE ENGINE AT ONE-THIRD LOAD.

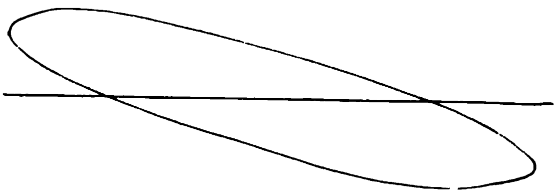


FIG. 6. CARD TAKEN WITH ENGINE AT LIGHT LOAD.

As the governor picks up and the valve stroke becomes shorter, the ellipse will take a slimmer form and will not project over the port line as much as seen in the card, Fig. 5, taken at about 1-3 load. When the engine is running light the ports will be opened very little, as seen by the card, Fig. 6.

The cards used have a line drawn horizontally through the center. The edges of the steam ports are found as follows: The valve chest cover is removed and the engine turned over until the valve is in the center of its travel. The arm on the rocker-shaft is then adjusted so that the pencil rests on this center line of the card. Then the engine is turned over until the valve is about to uncover a port or until the steam edges coincide, when a mark is made on the card where the pencil rests. The same is done with the other port and lines drawn through these marks parallel to the center line, indicate the steam edges of the ports and the distance as shown in Fig. 7. The ellipse projecting over these, above the upper and below the lower lines will be the amount of port opening on the head and crank ends of the cylinder, respectively. For simplicity the plain D valve is used in the diagrams, instead of the Giddings valve in the Russell automatic engine. The D valve in the diagrams is not intended to be drawn to scale, or to have the right proportions, but the scale of its travel is the same as that shown on the cards in Figs. 2, 3 and 4, but is only about ½ that of the actual cards taken from the engine, numbered 5, 6 and 7.

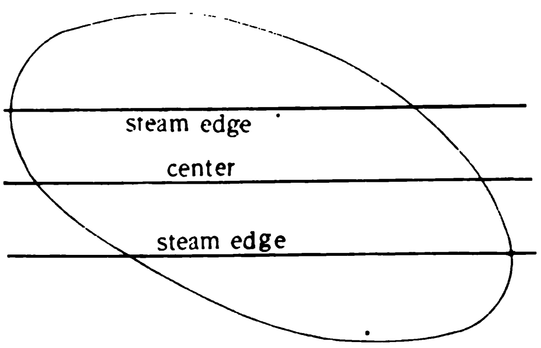


FIG. 7. REPRESENTING THE PORT OPENING ON BOTH ENDS OF THE CYLINDER.

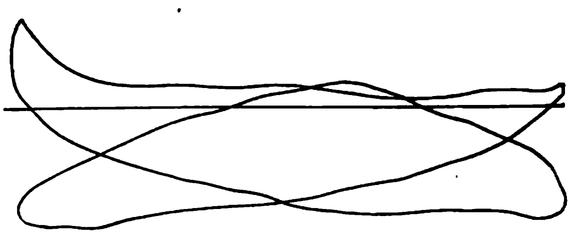


FIG. 8. WHAT IS THE MATTER WITH THIS CARD?

Fig. 8 is a freak. What is it? F. J. Potter.

Keying Up Engines.

Editor of the Engineers' Review:

In a recent issue of the Review I read where one of your correspondents stated he did not think it a good idea to key up an engine after shutting down at night, because of the possibility that another engineer might be called upon to operate the engine the next day, who, not knowing that the crank had been keyed up, might possibly allow it to get hot and injure the brasses. This is an old handed down saying that has been going the rounds for a good many years and while there may be something in it, it does not appear to me to be so important as some engineers would have us think.

When an engineer keys up an engine he usually does it so that it will not run hot, if he knows his business, therefore if it is keyed up as it should be it ought not to make any difference whether he or some other engineer starts up the next morning. An engineer can tell by the sound of his engine just how much keying up is required and in my experience I have never designated any particular time in which keying up should be done. It is the most natural thing in the world for an engineer to key up after shutting down at night, because then he can take his time doing it, which is something he often cannot do if he permits the job to go until the next morning.

Some of the letters would suggest that the authors consider the majority of engineers very much abused individuals. This may be true in a good many cases, as some employers pay attention to what persons say who have no interest whatever in the business, outside of that of a trouble maker, in which case the engineer if he does not stick up for his rights may be in a position not to be envied. A good many engineers are afraid to approach their employer as to repairs or alterations and seem to act as if they were asking a great favor when requesting that certain things be done.

Others get the idea into their head that the engineer in a nice clean plant and working for a man that gives him every article he orders, is a man who is particularly favored and has got what some call luck working with him; others designate it as a pull. I used to use this expression myself, but had it entirely knocked out of me one day while in conversation with the chief fireman of the power plant of the Boston Elevated power system a few years ago. While in conversation with him I made some remark about how it must have taken a pull to secure such a position. His remark was that "Pull didn't amount to a —— in that plant," and the only way a man could get in there was by proving he had the goods to deliver, or words to that effect.

I went away thinking along a different line than what I had before, and I have come to the conclusion that the chief fireman was correct. If a pull did not amount to anything in that fire room, it certainly does not in the engine room, and although there may be cases here and there where a man holds his position because of someone's influence, it is a pretty sure thing that he will come to grief in time, unless he has the making of an engineer in the first place. L. G. R.

Cylinder Troubles.

Editor of the Engineers' Review:

I have been an interested reader of the Engineers' Review for some time and I am very much interested in reading about the troubles of other engineers, especially Bill B. Banger, who certainly gets up against the real thing.

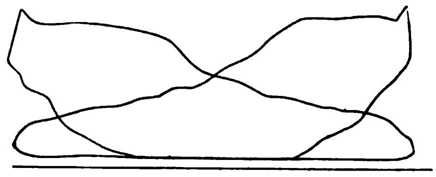
I am employed as an assistant engineer in an electrical plant and have two 14 x 18-inch Sterns' engines of 125 horsepower each, and one 9½ x 12-inch 50 horsepower engine of the same make, direct connected.

About a year ago our No. 2, 14 x 18-inch engine began to go wrong by giving a little rap in the cylinder, giving a few raps and then stop. It sounded as though it was getting a slight dose of water. Sometimes it would run an hour or so without a sound and then suddenly give a few more pounds and then stop again, although the water would be all right in the boilers. I finally took off the cylinder head and examined the cylinder and piston. I found on each end of the cylinder a very small shoulder extending about half way around the cylinder. The shoulder was about where the travel of the inside ring ended at each stroke. I took a scraper and worked the edge of the shoulders down until they could scarcely be noticed. The piston is of the spider and bull ring type, and as the piston seemed to travel closer to the side having the shoulder, I threw it over a little, and after putting the head on, started up.

The engine ran as smooth and nice as one could ask and I thought my trouble was ended, but in about three hours after that I learned that my trouble was still there, and it soon began to rap at both ends of the stroke, getting worse and rapping louder. I took the head off, and shifted the center of the piston first one way and then another, but every time I made a change it was worse. I next centered the piston in the cylinder, and started up, but it had no effect on the trouble.

I took a few cards during some of the worst freaks of pounding and got a fairly good card for that class of an engine, according to my judgment, which is not first class.

We were finally advised to raise the rod at the crosshead, which was done until it travelled about 1-16-inch higher at the crosshead. At the same time a new set of rings were discovered, and as the old ones were a little bit worn, we put the new ones in and when the engine was started, it ran as smooth and nice as it ever did.


CARD TAKEN DURING A POUNDING PERIOD.

I do not know which stopped the trouble, the new rings or the raising of the rod. I am inclined to think the former, as when the piston-rod was centered in the cylinder it did not seem to ride on the stuffingbox.

The accompanying card was taken during one of the worst freaks of pounding. I would be pleased to have it criticized. W. A. H.

Hot Bearings.

Editor of the Engineers' Review:

Probably one of the troubles the engineer most dreads is that of hot bearings and because of them more trouble than a little can fall upon the engineer. When he sees or smells a hot bearing he immediately thinks of melted boxes, possible shut downs, superiors tearing around like madmen and other unpleasant things. Sometimes it merely amounts to worry on the part of the engineer, while at other times all he has dreaded becomes a reality.

Undoubtedly the hot bearing is a sign of neglect, although many times it is excusable in a measure so far as the engineer is concerned. Sometimes the neglect may be carried back as far as the builder or even the designer. Many times it is the fault of the owner who insists upon the engine carrying a far greater load than it was designed for.

Every engine may be expected to carry a reasonably heavy load, but when the load becomes excessive there is an excuse for the bearings heating up, and the matter of lubrication becomes a problem and only the greatest care taken will enable the engineer to continue running.

Not infrequently hot hearings are directly traceable to neglect by the engineer. He may have forgotten to open the feed of his oil cup when starting up. Possibly the oil cups ran dry for some time before the fact was noticed. Perhaps he used a piece of waste in wiping off his main bearing which had fallen on the floor and become full of sand, thus getting sand into the bearings.

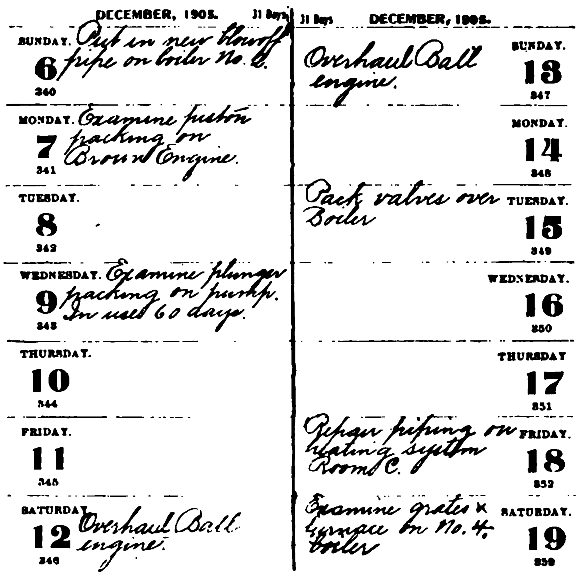
There are many remedies for treating hot boxes, among which are black lead, white lead, ammonia, sulphur and lead, salt pork, brine, molasses, soft soap, graphite and a dozen others. One method used with more or less success is that of washing out a bearing with kerosene oil and then dose it liberally with a good quality of engine oil. Care should be taken, however, in using it as the kerosene will cut the oil in the box, which may result in more heating if care is not taken.

Probably the best way to fix a hot box is to make sure that the shafting or brasses are in line and then, after proper scraping, there will doubtless be no more trouble. Often a change of oil will bring about good results. I have known this to occur where nothing was done with the exception that the old oil was drawn off and new oil substituted. This was the case of a bearing having an oil ring which got so hot that the bearings were smoking when the machinery was shut down. After changing the oil the machine was started up and no more trouble was had with it L. Winch.

Marking Ahead.

Editor of the Engineers' Review:

I have noticed in reading over the Review that most every kind of a record has been published that will be of benefit to engineers. There is, however, one other kind of record which has not been touched upon to my knowledge, that of marking or booking ahead. Engineers know that system is the main thing in carrying any work out to a successful end. This applies to engineering as well as to other work, and in plants of any considerable size it is impossible for the engineer to remember all the things he has done, or the things he expects to do. This will apply also to any ordinary size plant, say of 100-horsepower or over. For instance, in making a boiler inspection the engineer sees that the blowoff pipe shows signs of weakening. He makes a mental calculation as to the probable safe time he can allow the pipe to stay in. He figures that it will *be safe to allow* it to stay in until a certain date when he knows he will be able to repair it, which, we will say, will be Sunday, Dec. 6, 1905; therefore on that date he will mark ahead and write in the space allotted for that date: "Put in new blowoff pipe on boiler No. 2." It may be way back in the month of July or August when the entry is made, but if he is faithful in keeping in touch with his marking-up book there is no danger of the item escaping his notice.



DECEMBER, 1905. 31 Days

SUNDAY. 6 340 Put in new blowoff pipe on boiler No. 2.

MONDAY. 7 341 Examine piston packing on Brown Engine.

TUESDAY. 8 342

WEDNESDAY. 9 343 Examine plunger packing on pump. In use 60 days.

THURSDAY. 10 344

FRIDAY. 11 345

SATURDAY. 12 346 Overhaul Ball engine.

31 Days DECEMBER, 1905.

Overhaul Ball engine. SUNDAY. 13 347

MONDAY. 14 348

Pack valves over Boiler TUESDAY. 15 349

WEDNESDAY. 16 350

THURSDAY 17 351

Repair piping on heating system Room C. FRIDAY. 18 352

Examine grates & furnace on No. 4 boiler SATURDAY. 19 353

PAGES FROM A MARK-UP BOOK.

A day or two later he may put new jacking in his engine. The agent who has sold it to him has claimed that at the end of a certain time the packing will be in as good condition as when put in. We will say this date falls on Monday, Dec. 7. Therefore in the space allotted to Dec. 7 he writes: "Examine piston packing on Brown engine."

Coming along to Tuesday we find nothing. On Wednesday, Dec. 9, we find "Examine plunger packing on pump; in use 60 days." This means that the engineer desires to ascertain the condition of the packing at that time to see whether it is wearing as well as another kind.

On Saturday, Dec. 12, and Sunday, Dec. 13, we find the item "Overhaul Ball engine." On Tuesday, Dec. 15, we find the item "Pack valves over boilers." Opposite Friday, Dec. 18, we find the item "Repair pipe on heating system, room C." Saturday, Dec. 19, we find that the furnace and grate are to be examined on No. 4 boiler.

These two pages taken from my mark-up book show what I mean by marking ahead. Anyone can see the advantage of such a system and what a convenience it is in keeping track of all details. For instance, the engineer six months afterwards can look back and tell at a glance just what was done on a certain date.

I trust that this may be of value to some of the Review readers. J. VanDorn.

Piping.

Editor of the Engineers' Review:

It is astonishing the number of poor jobs of pipe fitting there are, that do their duty regardless of the criminal carelessness or rank ignorance displayed in their construction. One seldom has to travel far to find some jobs that would prove a wonder to a good steam fitter. Some have no regard for the appearance of the job or to the convenience of the valves and unions. I have noticed lines 200 and 300 feet long and under ground at that, without a union in the entire length.

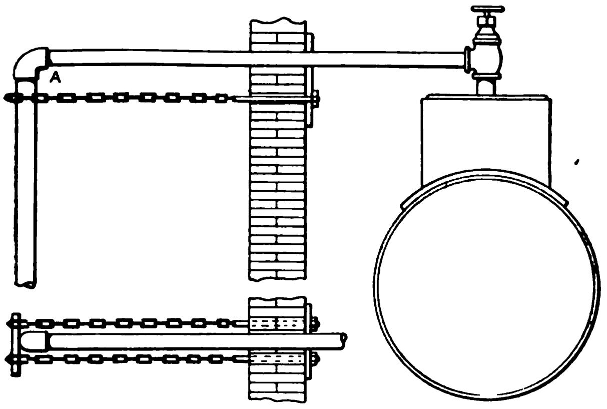
Steam pipe and fittings, like everything else have their limit of endurance and when natural laws are chained down, tied up or nailed to some convenient post, something is going to part.

Some time ago, at one of the large mills here, a new Corliss engine was installed, and the 6-inch steam line was run from the boilers as shown in the illustration. After the plant had been in operation a day or two, the engineer noticed that the elbows and flanges were leaking. He tried to tighten them up, but this proved of no material help, as within a short time they would start blowing again. He decided that for some cause the pipe moved endwise. In order to overcome this difficulty, he placed two 1-inch log chains around it, as shown, in order, as he expressed it, to make the pipe move the other way. The pipe did move that way, but it split the ell *A*, from end to

end, forcing the engineer to make a hurried escape through a window, without taking time to raise it.

If he had known there was such a thing as expansion and laws thereof, he would never have tried to chain his steam pipe down, but would have tried to remove the cause of the pipes moving.

Another case showing the ignorance of the laws of expansion is as follows. A company desiring to put in a new engine room, 200 feet from the boilers consulted the engineer in regard to the pipe expansion, desiring to know how much the pipe would expand. The engineer after figuring a moment said he though the expansion would be about 3 feet 9 inches. The superintendent inquired what he would do to overcome this rather unlooked for feature of their plans. The engineer looked wise and replied that he would fix that all right. The superintendent was not satisfied with his plans and another engineer was asked to take his place and overcome that remarkable case of expansion.



MANNER IN WHICH THE PIPE WAS SECURED.

It is probable that any engineer could relate his little stories of the punishment pipes have to undergo at the hands of ignorant engineers, who feel that they are above asking questions, fearing they would not be considered competent. Jack.

How Much Oil Should Be Used?

Editor of the Engineers' Review:

I would like to ask the readers of the Review about how much oil it should take to run a plant for say 30 days, an average of 10 hours each day, having the following engines: One Ideal automatic self-oiling 15 x 14-inch, running 280 revolutions a minute, direct connected to a generator, 550-volt, 182 amperes, running 18 hours every day. A Buckeye automatic cross compound engine, 16½ x 28½ x 18 inches, running at 200 revolutions a minute, direct connected to a 220-kilowatt alternating current generator. We have also a Gates automatic 15 x 14-inch engine running 300 revolutions a minute, direct connected to an 80-kilowatt alternating current generator running about 10 hours each day. In pumps we have a duplex, 18 x 14 x 18-inch, running 24 hours each day, two duplex boiler feeders, 6 x 4 x 6-inch, one running all the time. Now, I would like to know how much oil ought to be used to keep this plant running in a first class condition. I use Atlantic red on the bearings and 600 K. W. in the cylinder. I would like to hear from some of the engineers about this. A. F. S.

Hydrostatic Tests.

Editor of the Engineers' Review:

Many engineers are of the opinion that it is an easy matter to conduct hydrostatic tests on a boiler. Besides the danger of reaching an overpressure when conducting a hydrostatic test, greater precaution must be used when two or more boilers are connected together. In such a case it is not safe to attempt to apply hydrostatic tests while steam is on the other boilers. This is because of the contending forces of expansion and contraction which are at work, when comparatively cold water is pressed upon one side of a separating valve, while there is steam pressure on the other. Such action must necessarily cause an unusual stress to be sustained by the metal in the valve and it will be most fortunate if nothing more serious results.

In case the valve is injured there will be a loss of time in conducting the test and a loss of the boiler under steam in being cut out, or placing the new valve, as well as the loss of the valve itself. It is evident that the valve should be subjected to one temperature only, which should be that of the water used in testing the boiler, and in order to do this some sort of a plan must be devised to prevent the steam pressure from acting upon the valves. This may be done by making use of a blank flange, which is placed in a joint near the boiler which must be disconnected for the purpose. This will effectively interrupt the pressure of the steam to the valve, and therefore relieve it of any undue stress it would be obliged to sustain if this were not done.

The objection to this plan, however, is the time it takes to make the change, whenever the test is made, besides springing the pipes apart when inserting the blind flange. The last performance does not add to the good condition of the pipe line.

A method that I have seen used in conjunction with water tube boilers, is to have two stop valves in the steam pipes leading from the boilers which are located close together and separated only by a nipple. To the nipple is connected a drain valve in order to take care of leakage or condensation. When both of these valves are closed before a boiler is tested, each one will only have to bear the temperature of the fluid which is against it, the space between them being empty, except of air. Any one having occasion to test boilers frequently will find that this is a good method to use.

I. S. D.

Water Column Valves—Plugs.

Editor of the Engineers' Review:

I noticed by A. Rossbach, Jr.'s, letter in the July issue of the Review, page 22, that he does not see any use for the valves between a boiler and the water column. I would like to ask him what he would do, should anything go wrong with the try cocks, or should a leak occur between the steam gage cock and the water column? Would he shut down the plant and make repairs?

I recall an experience I had a short time ago. There is a union between the boiler and water column on one of my boilers. This union started to leak badly one day. All I did was to close the valve between the boiler and the column, and put in a new gasket, but if the valve had not been there I would have been obliged to shut down the plant.

If I should ever have charge of a boiler which had no valves between it and the water column, I would see to it that they were put in as soon as possible.

I see that Smut Face uses a bushing and plug to stop up a tee or ell. I do not see any use in doing that. If the threads on the plug are covered with graphite mixed with cylinder oil before putting it in place, there will not be any trouble getting them out again, even with a good monkey wrench. There are plugs on the lower pipes of my water columns and also on the blowoff pipes, which I remove every two weeks to clean them out. These plugs have been in use for the last six or seven years and I never had any trouble in getting them out.

H. J.

Tube Cleaner Caused a Surprise.

Editor of the Engineers' Review:

We had this experience in our plant recently: We have two S. F. Freeman boilers, marine type, of 200 horsepower each. We have been using compound right along and thought our boilers comparatively free from scale. The other day the manager purchased a hammer tube cleaner, and on using it the results were surprising. We took from both boilers at least 1,000 pounds of scale, in two days.

The cleaner has not injured the tubes in any way, shape or form, as far as we can see.

G. H. Atkinson.

Boiler Moving.

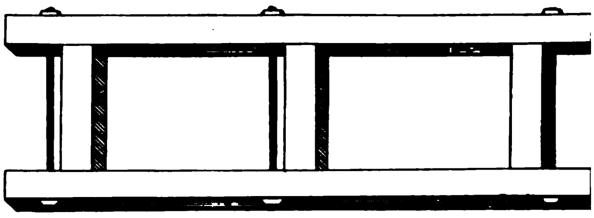
Editor of the Engineers' Review:

I once had a little hurry up job moving some boilers, the account of which may prove interesting to your younger readers.

I had just completed the installation of 600 horsepower of boilers of the water tube type, that were to replace the three 100-horsepower horizontal tubulars, then in use. A new boiler room and stack had been built and everything was ready but making the last connections to the engine and piping system. I had a man helping me to get these last measurements one Sunday morning, when the manager came in and said he had sold two of the old boilers, on the condition that they were to be ready on the cars for shipment by the following Wednesday, at 2 o'clock p. m. Could I have them ready? I told him I would and then it was up to me to hustle things. I completed my measurements and starting up the shop, cut and fitted the two 6-inch and one 4-inch connections that were necessary. Getting in some more men these were erected in place that night and the old boiler connections broken and plugged.

The next morning the fronts and stays were taken off and the boilers stripped. A crib work of blocks was then placed under each end of the boilers, and with jacks were raised clear of the settings and securely blocked. A gang of men then pulled down the brick setting. Meanwhile I had the carpenter get out some skids of 6 by 8-inch timber, as shown in the sketch. As soon as one of the boilers was clear enough to work on, it was lowered down onto a skid. While this work was going on, I had a hole made
the boiler room wall large enough for the boiler
pass out, and by the time I had the track ready
first boiler was on the rolls. Hitching the blocks
the skid we soon had the boiler walking out in g
shape. Tuesday morning at 10 o'clock this boiler
on a car, with all the fittings, securely braced and re
for moving.

In the meantime the other setting had been remo
and the rubbish cleared away so we had a clean sw



SKID FOR BOILERS.

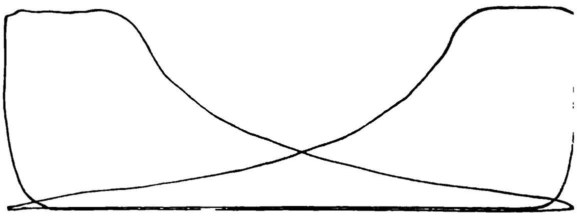
at the other boiler and Wednesday morning at 7
o'clock everything was ready for the freight. T
job might have been accomplished more quickly if
had had better facilities and competent help, but a
only had two white men besides myself, the bulk
the work was done by negroes. I think the time u
was very reasonable, but only those of your read
who have dealt with the average southern negro
appreciate the above statement at its true value.

L. L. Arnold

Grates, Tube Scraper, Stokers and Back Pressu

Editor of the Engineers Review:

I have noticed from time to time remarks anent
cleaning of water tube boilers, and they are certai
mean things to get clean at times. At one plan
had two Babcock and Wilcox boilers using river wa
pretty thick with mud, and while we had no s
whatever, it was a case of clean out mud pretty of
The regular scrapers were of no use for this
the various schemes I tried did not give satisfact
for one reason or another, so I made a swab of five
six layers of six ply rubber belt, with a nut and was
on each side to compress them together. I found
gave entire satisfaction as it would push out eit



CARD SHOWING SLIGHT BACK PRESSURE.

soft or dry mud, and as soon as it began to wea
could slip on another washer of belt which was cut
full size of the tubes.

In regard to stokers, they, like many ot ines, are all right as long as everything is e pink of condition, but in a plant containing 12 em, it took a machinist about all his time to keep in running order. The firemen employed to do and firing were four negroes at 85 cents a day under the supervision of a competent white man, tended the water and looked after things generally. n the stokers were installed, it was understood that rienced labor was unnecessary, so they were sup- d to be in better shape than before. The same fire- were kept on the job, however, and made to keep oppers full and do the cleaning out. It soon tran- d that one or more of the stokers was generally f fix in the steam end, while occasionally the men d drop a miners wedge into the hopper with the and then there would be something doing.

another plant using stokers a full quota of supply were kept in stock at all times, and these with assistance of the repair man, managed to keep s in fairly good running order.

ave noted some remarks on back pressure in non-ensing engines and show herewith a card taken e from a Harris-Corliss engine 18 by 42 inches, 7-inch exhaust pipe of which went under the e room floor to the wall, up a 15-foot riser then ran to a Cochrane open feedwater heater, ng through six elbows, a gate valve and 68 feet pe enroute and the back pressure was not at all ssive, even when the engine was carrying a heavy

L. L. A.

Homemade Feedwater Heater.

or of the Engineers' Review:

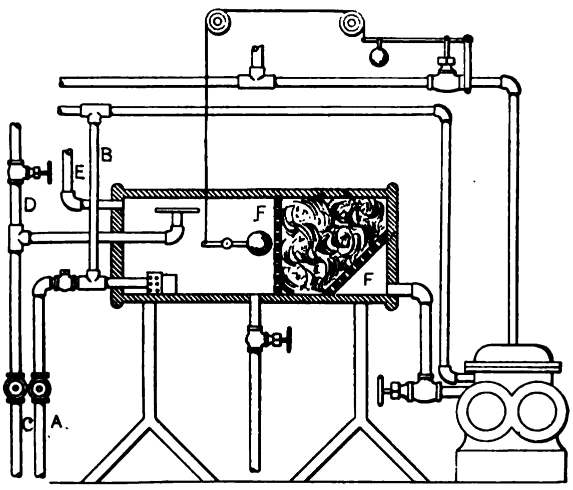
ave had the following described feedwater heater pump regulator in use for some time. Our en- has operated condensing and before I made this r I had a hot well located below the engine room and the feedwater had a lift of about 5 feet to ump.

e exhaust from the feed pump and the condenser arged into this hot well, as did also several ng coils. These heating coils were regulated by ordinary globe valves being used for this pur- I have always found that where heating coils egulated in this way by inexperienced persons, or less steam is wasted. It seems to be a hard r to teach some people that it is only necessary low the condensation to escape. I had formed a of going around to the heating coils several times and partly closing the drain valves, but results not satisfactory. Someone was sure to open again as soon as I got out of sight. Engineers have operated heating coils in shops or factories probably had the same trouble and can appreciate ituation. Under these conditions it was necessary ve an overflow to the hot well and have a stream ld water running into it at all times, for other- the water would get so hot it could not be ed.

wanted this heater to take the place of the hot and have it located above the pump. It also care of the drainage from the heating coils. This n old closed type of heater the coils of which had worn out. These old coils were removed and the r piped up as shown in the illustration. *A* is the n pipe from the heating coils. I also placed a valve in this pipe, as, when too much steam was allowed to pass through the heating coils I could close this valve instead of going through the shop and regulating each heating coil. The exhaust from the pump and condenser enters through the pipe *B*. The supply water enters at the pipe *C*, which comes from the condenser. *D* is another source of supply. The pipe *E* is open to the atmosphere. The float regulates the speed of the pump and automatically takes care of the drainage from the heating coils. A small chain runs from the float over two pulleys to the valve in the steam pipe. This valve is an ordinary globe valve, having the threads cut off its stem. It needs no further description as its construction is plain from the sketch.

Perforated plates were placed in the heater as shown at *F, F*, and the space between them filled with excelsior, the idea being to prevent oil from getting into the boiler. But this precaution was found unnecessary, as there was not enough oil going through the heater to cause any trouble.

The heater makes some noise when it is started. This is due to the exhaust steam entering below the water line, but the noise soon stops and is not heard again unless the temperature of the water gets below 180 degrees, which seldom happens as there is always enough steam to heat the water to the boiling point.



HOMEMADE HEATER AND PUMP REGULATOR.

I have been running a hot air heating system for a few years and have had considerable trouble with it. I have concluded that there is no heating system that will satisfy the workmen of a factory as some workmen are always cold and others always too warm. I try to keep the temperature of my factory at 70 degrees. This is not difficult in ordinary weather, but when the temperature of the atmosphere is at zero or less I think I am doing well to have 60 degrees in the factory especially in the morning.

I can raise the temperature of the factory 20 degrees in one hour. I always leave the windows to the coil closed until the factory is warm and then a window can be opened to supply fresh air if necessary. In most cases there is enough leakage through the doors and windows to supply all the fresh air necessary.

I think that the successful operation of one of these heating systems depends a great deal on the way the hot air is distributed. Our hot air pipes are overhead and when they were first installed the air was discharged horizontally across the room and none of the hot air ever got to the floor until the top of the factory was warm, in fact the building had to be heated from the top down. Elbows were placed on the hot air outlets and the air directed towards the floor. This did much better.

I have an idea that if the hot air pipes were placed under the floor it would tend to keep the floor warm and if the air was discharged through suitable registers so that it would spread over the floor we would not have so much trouble with this system and for factory heating it would be hard to beat, for it is easy to regulate. J. Y.

Right and Left Hand Threads.

Editor of the Engineers' Review:

Will you kindly submit the following question to the readers of your paper?

Why are pedals of bicycles made with right and left threads to screw into the right and left cranks respectively? The motion of the pedal relative to its pin is in the direction the pin screws out of the crank. If the parts are interchanged so that the drive is on the left side, the pedals work loose, while they are revolving on their pins in the direction that the pin screws into the crank. Motor.

Incidents of the Fire Room.

Editor of the Engineers' Review:

Relative to the many topics written about a steam and electrially driven plant, it appears that the fire room, where the source of power, economy, danger and strict attention is expected and desired, is being "cut out," as it were, or not receiving due attention at least through the mechanical journals. Only occasionally do we see this practical and important fact taken up, and it seems reasonable that there is much to be written of fire room experiences as well as engine room experiences. It looks as though most engineers are ignoring the fact that they ever had any knowledge of the fire room, but for my part I think it one of the first and most important places to keep in touch with.

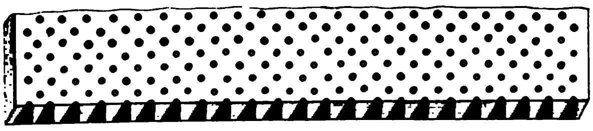


FIG. 1. UPPER SURFACE OF THE GRATES.

At one time I was employed as assistant engineer where we were using No. 2, buckwheat coal. It was thought by the chief engineer that the boilers were taxed to their utmost capacity, as the damper had to be open most of the time. I felt sure there was something wrong as there was no apparent decrease in the coal pile. I gave the boilers a personal inspection one Sunday while they were shut down, to try and locate the difficulty. I first inspected the grate bars to see if they were in a good condition and to my surprise I found nearly two-thirds of the air holes plugged up with nails. These kind of grates were designed especially for this grade of coal.

Fig 1 shows the upper surface of the bar and Fig. 2, the under side. They were made 3 feet long by 6 inches wide, the air holes being made spiral shape ⅜-inch in diameter at the grate surface and 1¼ inches on the under side. The holes were 2 inches apart on the grate surface.

It had been the custom here to burn the accumulations from the carpenter shop about every other day. The sawdust, etc., contained a good many nails which soon found lodgment in the holes in the bars, thus choking the draft.

On another occasion some of those bars got broken and as we had none on hand to replace them, we had the carpenter make some wooden ones the same as the original, which answered the purpose for the time being. Of course we had to cover them with ashes before we spread the fire on them. This was an emergency case which we overcame without any inconvenience to the firm.

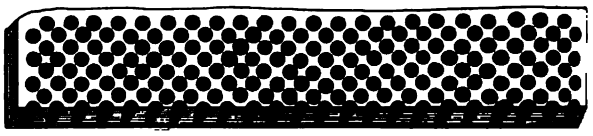


FIG 2. UNDER SURFACE OF THE GRATES.

As all of us are not familiar with the system of burning fuel, in wood turning and planing mills, it may not be out of place to show how one plant of this kind, I happened to visit recently, was systematically burning fuel. Fig. 3 shows that the fireroom floor is on a level with the furnace doors, the ashpit being below the floor level so it is only necessary to shovel the fuel in with a wooden hoe, made with a long handle with a piece of board fastened across the end of it. A draft stack about 3 feet in diameter and about 7 feet high from the ground placed outside the door and leading to the ashpit, furnished the draft for the furnace. The boiler was situated so the ashpit could be cleaned out from the side wall.

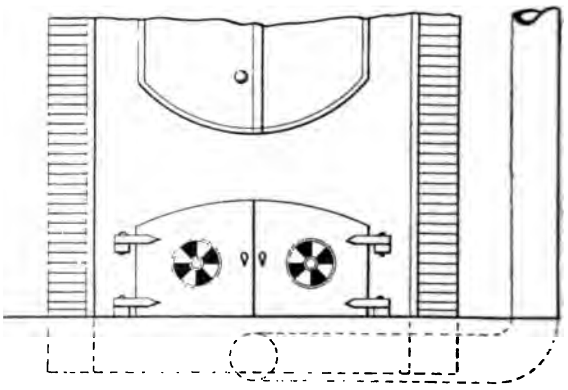


FIG. 3. FURNACE DOORS ON A LEVEL WITH THE FLOOR.

There was considerable trouble experienced at a factory in this neighborhood recently, by the boilers suddenly getting insufficient draft, which was very unusual. The cause was a pile of cobblestones which had been dumped at the base of the chimney by some ss person, and in consequence the door which een put in the chimney base had been broken s the stones were piled up around it they ob- d the door from view, but a large amount of air dmitted to the chimney at this point. After much trouble and worry it occurred to the engineer in e to inspect the chimney at its base and upon ing the stones he discovered the cause of all ouble.

Jas. G. Sheridan.

Systematizing Engineering Work.

r of the Engineers' Review:

s no uncommon thing to go by an engine room nd the engineer at work on Sunday or a holiday, little things which might just as well have been some time during the week. This is not a neces- y any means and could be avoided if the work d the plant was systematized so that the engineer know what he had to do and have a time for it.

nakes no difference as to the size of the plant, greater and more difficult to operate, the more ighly it should be systematized. If a man is con- iting installing a plant he goes about it in a sys- c way, and, unless he is a novice at the business, ows just what he wants, what he is going to do e way to go about it, before he begins. If he t he will make a mess of it.

aking charge of a plant there are many things to ore an engineer will get everything to suit his leas. Probably no engineer ever took charge of t and found things just as he wanted them. In g changes the jobs that are most necessary to e should first be noted and after deciding on the and quickest way to bring about the change, them. More than one engineer has jumped at st plan that appealed to him for doing a piece of where if he had waited, a better plan would een suggested. It pays to take time and pains a job in a first class manner and in doing this, be surprising how soon a plant that has been own will begin to improve in appearance and ach day's work easier.

only should the important branches of the work tematized, but the routine work also. That is, certain time and way for doing certain things. he matter of wiping an engine, although simple, ight and wrong way of doing it, and very often gine will protest in looks, if not in words, to nner in which the wiping is accomplished. The way of doing this is to wipe all polished sur- with clean waste, and portions of the engine are comparatively free from oil with slightly waste. When the waste gets too dirty to use in y, save it for wiping out around the stuffingbox, ad and around the pillow blocks. In following an the engine is kept in a better state and less nd waste is required than in any other way. r thing, an engine should be wiped down at least day, and in some places twice will do no harm, occasional extra rubbing at such places where accumulates.

manner of oiling an engine, although simple, be systematized. A man ought never to start ine until it is properly oiled, although this is ing that is done time and time again. The oil ould always be opened up and regulated to drip the proper amount before the engine is started. Failing to do this one day and doing it the next, keeps an engineer guessing as to whether his cups are operating properly or not, and the probabilities are that some day he will forget to open up a particular cup, which will make itself manifest later on in the run. If he has a system regarding this, there will be little danger of forgetting. No matter how well a journal has been running, a system should be adhered to which will bring the engineer around to feel of the journals at least every half hour. If he does this he will, in all probability, detect any heating before serious results can follow. With high speed engines, more oil and closer attention will be required.

The main thing in operating a steam plant is to use brains rather than main strength. Then it will be discovered that more work can be done easier, and with less trouble, than in any other way. If system is used, when an engineer gets through his routine work for the day he knows he is through until the next morning, when the same operation has to be repeated. Of course, this is subject to change without notice, as they say, in case of breakdowns, etc. I have followed this plan for some years past and nothing could influence me to go back to the old hit-or-miss way of caring for a steam plant.

Chas. W. Cooper.

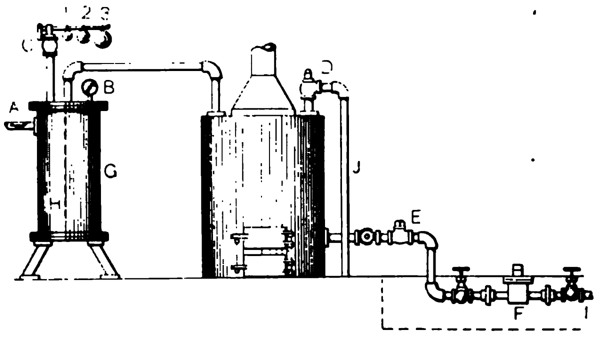
Trouble Caused by a Check Valve and Weights on the Safety Valve.

Editor of the Engineers' Review:

My attention was called the other day to a building in the vicinity of where I am employed, which contains a hot water system for bathing purposes exclusively. As I entered the building the man in charge asked me if I knew how much pressure the new water works system carried on their lines and I told him that as near as I knew it was 75 pounds to the square inch.

The accompanying sketch shows the boiler room, the floor of which looked as though it had been covered with water very recently and I questioned the man in charge who pointed to the 2-inch pipe at *A*, as shown, and said that it had burst there during the night. I examined the pipe and found it pitted some at the split. I then turned my attention to the steam gage at *B*. We took it down and after a careful examination I found it had registered above 350 pounds to the square inch for the quadrant was dislodged from the pinion that operates the hand. I next discovered a lever safety valve with three weights on the lever, as shown at *C*.

I asked the man what it meant and he said, only to avoid the mess the water made as it ran down over the tank and onto the floor. It leaked all the time and he thought weighting the valve the best way to prevent it. I next traced the source of supply of the water and found the cause of the excess pressure on the tank and boiler. The 2-inch straightway check at *E* would allow the water to flow into the boiler from the street main as long as there was 75 pounds on the boiler, but when no water was being used, and the boiler had a fire under it, and no possible chance for a release at the safety valve *C*, the pressure had to rise. The result was that the pressure gage had to be renewed, and a new pipe was put in at *A*, and some means established to release the boiler, so a relief valve was put on it at *D* and the safety valve at *C* discarded entirely. The relief valve was set at 90 pounds per square inch, to allow for excess pressure on the street mains in case of large fires. The check at *E* had to be maintained to prevent the hot water backing into the meter and possibly destroying it. The pipe *J* leads to the sewer to drain any water that might come from the relief valve. The man in charge is wiser now and in the future will be more careful, and I will wager most anything that he will never put extra weights on a safety valve lever again. C. D. W.



WEIGHTS ON THE SAFETY VALVE.

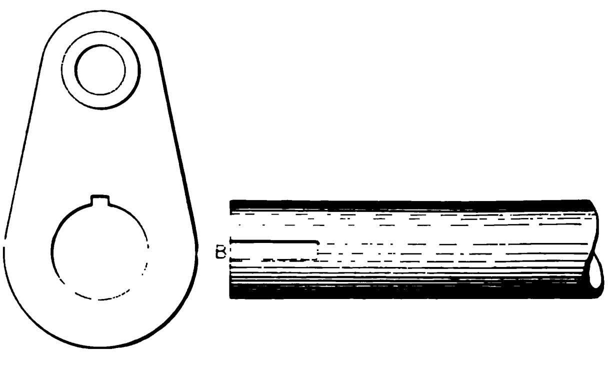
Steam Plant Troubles.

Editor of the Engineers' Review:

Some time ago we installed a 35-kilowatt generator for power purposes. When the machine was started, the voltage ran up as the load increased, which puzzled us as to the cause for some time, until one day I happened to think that perhaps the speed was too high. On examining the pulleys we found that the driver was too large. The machine was to run 650 revolutions per minute, while it ran 700 revolutions. After I put a smaller pulley on the counter shaft I had no more trouble.

The needle on my volt meter usually stuck at a certain point, and I had to give the meter a blow with my hand to start it. Upon examining the meter, I found that the cover was too close to the face of the meter. I put a ring of heavy paper below the cover, and this cured the trouble, which was very simple, but the trick was to find it.

On the duplex steam pump which was used for *boiler feeding*, the valve and seat on one side were cut very bad. I repaired it myself. I cut a small V shaped groove into the seats crosswise and then drilled four or five holes in the bottom of the grooves about ¼-inch deep, and then filled the grooves with extra hard babbitt metal. The valve was served in the same manner and then the seat and valve were scraped to a good fit. The holes were drilled in the bottom of the grooves so the babbitt would not come loose. When the pump was started again there was no leak in the valve. It has been running this way for six months.



KEYWAY IN THE CRANK AND SHAFT.

On this same pump I broke one of the crankshafts, and resorted to the following method in repairing it. The shaft and cranks being made out of one piece, I first drilled a hole into the crank and then got a piece of round iron the same size as the broken shaft and cut a key seat in both it and the crank, as at *B*, in the shaft. The crank and shaft valve were then fitted together and the pump started. H. J.

Simplifying Station Equipment.

Editor of the Engineers' Review:

As we look back and view the changes that have taken place in central station equipment, we note that the tendency is toward a general simplification of the entire plant. This has been brought about for two reasons: the desire to reduce the cost of the station and because the simpler the plant the more reliable it is, as well as a source of less expense in maintenance.

I remember when I first started out as engineer in electric lighting stations some 12 years ago, that if a short circuit occurred on a line it either brought about a disaster in the plant or the line was cut out of circuit in order to permit the others to be in operation.

I recollect one night shortly after starting up, the wires got crossed on what we called the south circuit which lighted the southern portion of a town in the middle west. The short circuit was so heavy that it was impossible to run with any degree of satisfaction and the line was cut out until the trouble man could locate and remedy the fault. Since then things have changed and today a short circuit on a line brings but very little risk to the station, because the power which flows through the fault represents a smaller part of the total out put of the station than was the case at the time I mentioned. Now it is not infrequent to allow trouble of this kind to burn itself out, or automatic switches may take care of it, which are so designed as not to open until some time after the fault has occurred.

The changes in the manner of layout of stations bring up points of interest, the old idea being to arrange the engines and generators so that any generator could be operated from any engine, which was accomplished by the use of the old-time line shaft. Everything was coupled together, that is, the engines were belted to the same line shaft as were the generators, which in direct current stations were operated in parallel. Running alternators in parallel, however, was a practice which although shown theoretically possible was not indulged in by the practical man.

The first departure from the old time installation occurred when the line shaft was eliminated. It then because impracticable to operate more than two or three generators from the same engine and it was not thought to be practical to allow one generator to depend upon one engine. The adoption of the direct connected generator, however, upset this idea entirely

today we find that in the best stations the generator
:pendent upon a single engine.
ıen we had boilers connected in parallel as well
ıe generator with engines running independently.
practice today is, however, to separate the boilers
group them into independent sets. The chief rea-
for this being the comparatively small floor space
ired by the direct connected unit, as well as the
er machine, the steam turbine, both of which sug-
a separation of the boilers into independent
ıps.
ı doing this, designers have left nothing in parallel
the exception of the generators at the bus bars,
:h, as in the alternating current, is exactly in op-
tion to the practice of 12 years ago, that is, at the
ent time boilers and engines are operated inde-
lently, while the alternators are in parallel, while
ıe olden days we put everything in parallel with
exception of the alternators.
will be seen at a glance that this departure from
:ime practice has the advantage of simplification.
ut the only disadvantage to be found is that when
:nerating set is shut down it involves the banking
:e boilers which operate the engine that is out of
mission, although in many stations cross connec-
s are so arranged that any set of boilers may be
·ated with any engine set. Geo. Squires.

Pipe Offsets.

:or of the Engineers' Review:
am sending in a few sketches showing how we
nged some 8-inch pipe that we were installing,
vercome some difficult angles.
ne was to overcome an offset caused by the 8-inch

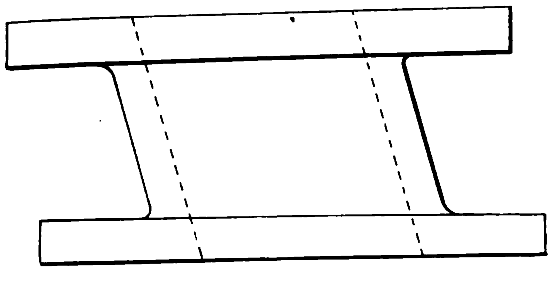


FIG. 1. OFFSET FITTING.

ge being riveted crooked to the new return tank
the elevators. Fig. 1 shows an offset fitting and
2 the elevation of the two elevator pumps and

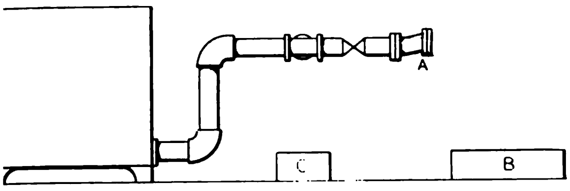


FIG. 2. WHERE THE OFFSET WAS USED.

:. The tank and pump were crowded well together
:h required the use of close nipples.
ig. 2 gives a good idea of how the piping was run
what fittings were used. We made the flange connection to the pump *B*, and when trying to connect to the same, found that the center of the pipe was 1 1-16 inch lower than the center of the suction opening of the pump caused by the crooked thread in the flange pitching down.

We tried cutting a crooked thread on a nipple, but the shortness of the nipple would not allow us to get enough pitch, so we had the special casting, Fig. 1, made and by using as shown at *A*, Fig. 2, were able to make the connection without any undue strain.

Another scheme was to turn an 8-inch pipe line to make an angle that was less than 135 degrees and greater than 90 degrees, caused by the odd angle of the building. Fig. 3, shows the arrangement. We used a 45 degree ell, a short nipple and a flange union between which we inserted the dutchman, as at *C*, which gave us the required angle. The dutchman is shown in Fig. 4. The holes were drilled large enough in the casting to allow the bolts to pass through. The slant was ¾-inch in 11½ inches of pipe length.

J. F. B.

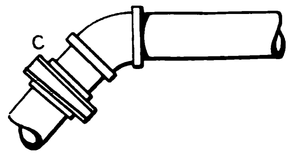


FIG. 3. FLANGE WITH THE DUTCHMAN IN PLACE.

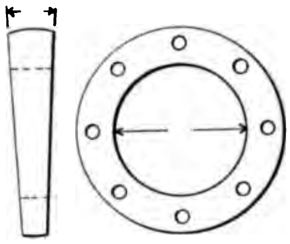


FIG. 4. THE DUTCHMAN.

Outside Work.

Editor of the Engineers' Review:

The letter by F. S. Jenkins, in the March issue, expresses my views on outside work exactly, and I believe his ideas on the subject are all right, and well expressed. There is, however, another point pertaining to an engineers' duties that should not be overlooked. A man that is worthy of the title of engineer ought to perfect himself in the theory of his chosen profession, so that he could be paid for what he knows, and not altogether for what he does.

How many engineers we see, especially those running small plants, and doing their own firing, who as soon as they get the plant in operation in the morning, seek their favorite chair and, with a dime novel before them, are soon lost in the subject of the book, before having done the usual cleaning, or even given their oil cups proper attention, to satisfy themselves that the oil is being used economically. When shutting down time comes, they have the fires banked, close the throttle, and run. After supper you will see them standing on the street corner or at places of amusements, with no thoughts of all the leaking valve stems, dirty engine, pumps and boiler fronts, that should have had a little of their attention.

These men, as a rule, never look into a book pertaining to the subject of engineering, nor do they subscribe for mechanical papers. They are never interested in engineering societies, because to attend the meetings would deprive them of too much of their spare time. They are always the ones to be dissatisfied with their positions, and are always looking for something better.

I know of a young man who ran a small plant in very much the same way. He would manage to get there sometime between 6 and 7 a. m. He usually had 10 or 15 pounds of steam which enabled him to put the steam jet on. He would pull down his fire and get steam quickly, and by driving his fire hard could get steam enough to start the engine in about 20 minutes. He never wiped the engine, nor swept the floor, and the ashes were never hauled until they were nearly to the grates. When the tubes became so full that he had difficulty in keeping up steam, he would run a $\frac{1}{2}$-inch pipe through them and get out a little soot. The combustion chamber was supposed to be cleaned once a year, but if at the end of the year he thought it would go a little longer before it was quite full, he let it go. He never had any system and was always putting off for tomorrow what should be done today. This man received $2 a day and is always complaining that he is not getting enough pay for his work.

After running this way for more than three years, he secured a position as chief engineer of a large mill, out of town, which paid nearly double the money he had been receiving.

His new career was of short duration, for in four weeks he was back again, and after loafing around two months, secured a position firing for less money than he had at first. He could not handle that mill and had he been near enough to have called on the superintendent, instead of corresponding with him, he never would have been given a trial.

In a city not far from where I live, a man with very little more experience than a fireman, secured a position in a small plant that had paid the engineer $2 a day, but this man asked for $2.25 and got it. The manager was a very neat man and was willing to purchase anything that helps to make up a modern plant. He had a hobby for a very neat engine and boiler room. The new engineer soon learned this and set to work with paint, whitewash and metal polish and had things as neat and clean as any place you could find. He then "hit" the boss for another quarter a day and got it. But after that his head began to swell, and the work did not seem so easy, and in a short time the place began to run down again. The manager spoke to him about it, but our friend simply said the job was worth $3 a day and if he could not get it he would not stay. The manager finally split the difference with him, giving him $2.75, providing he would clean the place up and keep it so, which he promised to do. As yet he has not done what he agreed to, and is holding out for $3, which the manager flatly refused to pay, and this man thinks he is the most abused man in the world. Had he kept up the good work so well started, and during his spare time studied up the business, to make himself competent, there is little doubt but that he would have received the salary he demanded. In other words, he could demand his price elsewhere, as he would have been able to hold a good position, but now he could not get anywhere else what he is getting there.

He is not asked to do work out of the engine room, nor does he have any piping to do, or even the valve stems to pack, for a local plumber does that work for him any time he wishes to call him. All repairs in this plant could be done by any man of ordinary experience, and would require very little overtime. These repair bills, when added to the operating expenses, make quite an item.

I don't believe a man ought to be asked to do work outside of the engine room, but I do believe that a man should do the work that is required of him. Then, if he finds time to sit down, he can do so with a clear conscience, even if it is 8 or 9 hours a day.

It is true, as Mr. Jenkins says, "There are many men today who are drawing large salaries," and are competent men, but how did they advance to such positions? Did they get there by sitting down in an engine room, whiling their time away over story books? I think not. Old Vet.

Hobo Advice.

Editor of the Engineers' Review:

One night as my night engineer was oiling up, a hobo walked into the engine room and asked for the privilege of staying over night in the boiler room, and as he claimed to be an engineer he was told he might.

We have two engines with automatic governors and one of them gave us a great deal of trouble in keeping the valve-rod packed so it would not leak. If we screwed the packing up tight enough to stop the leak, it made the governor rattle. We tried several different kinds of packing, but none of them seemed to fill the bill. That night the valve stem was leaking quite bad and the hobo spoke about it, and when told of the trouble said that if a piece of sheet rubber were put in between each ring of packing, it would help it. We tried it and to our surprise found it did help a good deal.

I notice in the Review that different engineers and firemen have different ways of cleaning fires, some advocate shoving the fire back, and then hoe out the dirt in front. Now I claim if they clean their fires in that way, they have only done about half a job when they get through. I think the only way is to fire one side quite heavy, and let the other side burn down. When it is burned down, pull all the dirt out clear back to the bridge wall, and with the bar slide the fire over onto the clean grate and let the other side burn down as much as possible, then clean it out and slide some of the fire back on that side to start the fire again. In that way one can get all of the dirt out. and I think this is the best method. Whiskers.

Bill B. Banger and His Critics.

Editor of the Engineers' Review:

I just got that letter you sent me, from Mr. Stanley of Ponca City, Olka. That place ain't pronounced as it's spelled. If you want to say it real bad, just say "Pon'ka" and you'll have it.

Stanley seems to be laboring under the hideous impression that I'm out of a job and kindly offers me the one he has. Now what does he think I want of a job out in "Pon'ka" City, when my mother-in-law will support me here, where we have something besides sand hills and gas engines.

He tells me what he has in his plant and then wants to know if he is loaded. Dinged if I know whether he means the engine or himself. If he means himself, I'll give it up, but from his letter I should judge that he might have had at least half a dozen eye openers

ıe set down to write. I suppose it is as easy
in "Pon'ka" City as it is in Bangersville.

; the engine that's overloaded, it won't take
find that out, if Stanley's figures are all right.
he has got a 12 x 12-inch Ideal engine, running
evolutions a minute and connected to two 110-
chines which have a load of 240 amperes each,
en run in multiple have 275 amperes each.
e engine has a rating with 110 pounds of steam
is carried on his boiler) of 113 indicated horse-
vhen cutting-off at ¼-stroke. Now to find out
at engine has to drive, we will have to get
figerin', and that is where he's got me where
home as I took first prize once when
the age when the sleeves of my jacket and the
of my pants were trying to see which would
o my neck first, and I ain't forgot how to sling
yet.

-candle power incandescent lamp takes about
es and a 240-ampere machine will handle about
ps. Each lamp will take 110 volts times .5
or 55 watts, and 480 lamps will take
5 =26,400 watts. As there's 746 watts in one
wer, each machine will take 36,400 ÷ 746 or

BY JINKS! STANLEY AIN'T LOADED YET.

power, and a little over. Both machines will
ut about 70 horsepower. He ain't overloaded
his machines run up to 275 amperes when
in multiple, he had better cut that way of
g out, as he can save about 60 horsepower,
ngine ain't loaded yet, any way he looks at it.
s a street light machine with 25 lights on the
I suppose that they are arc lights, at least that
I am going to figer on. If they are the regula-
l they will take 9.8 amperes each and 55 volts,
vatts each. The whole lot will require 539 ×
13,475 watts, which divided by 746 = 18
ver for the street lighting. Let's see, 70 horse-
o swing the incandescent lamps, and 18 to
e street flickerers going, is 88 horsepower.
, Stanley ain't loaded yet.

y gets more and more in the dumps as he
ng with his letter, and at last ends up with a
t the general manager is going [illegible]t a 15
220 volt machine for him to [illegible]p of
s got. This machine will take [illegible] orse-
ore, so I guess the general [illegible] retty

nigh right when he said that the engine could carry more load. According to my count the engine will only be doing about 95 horsepower when the new machine is hitched on. To be on the safe side we will throw in about 10 horsepower just for luck and the engine will still be good for 88 + 6 + 10 = 104 horsepower. 113 — 104 = 9 horsepower to the good that the general manager might as well use as not.

The engine is good for 113 horsepower cutting off at ¼-stroke, according to the makers rating, and could be made to do more work by cutting off later; say about 25 horsepower more, although it would not be working steam economically. No! the engine ain't loaded to speak of, but Stanley may be.

Now to get at the boiler and see if it is able to stand up under Stanley's firing and furnish the necessary goods for the engine. He has a 72-inch boiler, 16 feet long. He don't say how many tubes it has, or the size, so I will have to make 'um to suit myself. The boiler should have 102, 3-inch tubes, if it is like mine, or I should say the last one I had, seeing I am supposed to be out of a job, and I don't want to waste time arguing the point. That gives about 201 square feet in the shell and 1,281 square feet in the tubes, or a total of 1,482 square feet of heating surface. Now I don't know what ratio Stanley figures on for a horsepower, but in Bangersville, we generally calculated on from 8 to 15 square feet of heating surface for each horsepower, and as the Ideal engine is a pretty good one, we will be safe in figuring on about 12 square feet of heating surface for each horsepower. Getting down to figers again we find that 1,482 ÷ 12 = 123.5 horsepower. Now, there's no use talking on this subject any longer, neither the engine or the boiler is overloaded, regardless of what may be the matter with Stanley.

Stanley says that the general manager is going to run the return wire of the 220-volt machine to the negative wire of the 120-volt machine, and expects things to go on without a hitch. He wants to know what will happen. Well, it all depends upon what kind of a fuse he puts in on the circuit. If it's about a 20-ampere fuse it will blow, but if he strings across a piece of No. 0000 wire, there'll be some fireworks. Stanley can tell the general manager that he might as well begin to string his independent line of wires for the 15-ampere machine first as last as he will have to come to it anyway. If he insists that he is IT ,just take your uncle Bill's advice and let him go ahead. We all learn as we grow old.

Next, Stanley wants to know how to make a wooden pulley stick to a shaft driven by a D——— gas engine. That's a new kind of an engine in Bangersville, and I don't think it can amount to much. But about the pulley sticking to the shaft; I don't know as it makes much difference whether it is driven by the kind of a gas engine Stanley speaks of, or some other kind. It is just as easy to make it stick with one kind as with another. Take the pulley off and file the shaft where the pulley fits, with a bastard file, and when you put the pulley back in place cut two strips of coarse sandpaper to fit into each half of the wheel hub, with the sand to come next to the shaft, and then tighten up on the pulley the same as you would if you were gripping a $1,000 bill.

The last thing he says is that if I haven't got a job.

I can have his. I don't want his job. I wouldn't know what to do with it if I had it. I showed the letter to my assistant and asked him what to do about it and he thought that Stanley's engine would come in handy to put in the high pressure cylinder of our small engine to take up some of the clearance, but I won't agree to that, as the flywheel might get into the exhaust port and scratch the exhaust valve.

I don't know as the editor will let this go through or not, as I have kind of entered his sanctum sanctorium in answering these questions, but if he don't kick I will just tell Stanley and the other fellers who think that your uncle Bill is way behind the times, that I cut my eye teeth some years before I went to Bangersville to live, and that if there is any more of the same kind as the foregoing coming to me, that I'll meet 'um half way, if I have to hire the advertising pages to do it. Tow Lawson of Boston ain't the only one who's got money, and don't you forget it.

Bill B. Banger.

Deception is Unnecessary.

Editor of the Engineers' Review:

In the issue for July, W. E. Van Hoose gives us another very good illustration of the way in which some men prefer to deceive others, when it is not necessary. Let us review the conditions he presents.

A certain man bought an air compressor, driven by a cross compound engine. This engine was fitted with a by-pass, or as he describes it a "pipe running from the high pressure steam chest to the low." About every engine of this type is fitted with a by-pass, the object of which is to admit steam to the low pressure cylinder when the high pressure crank is one one of its centers, with the engine standing still, and it makes no difference whether this is few or many times per day. The purchaser of this machine claimed that it was properly connected and he was right, although this "trouble man" told him that it was not. This statement is based on the fact that it was made to run properly, when operated as it was intended to be, without changing the connections, according to his own letter.

It is quite plain that this writer did not understand this machine, hence should not have been sent out to instruct its purchaser. On arriving at the place he found that it would stop with the high pressure crank in a position from which it could not be started by admitting steam to the high pressure cylinder. Had he grasped the situation he would have at once informed the purchaser that it could not be run with the by-pass valve closed, as it must be kept partly open at all times when compressed air was wanted.

According to his statement he lost a good deal of time and patience in trying to prove that the machine was not practical, when in reality it was all right,and then spent more time in disabling the by-pass valve, also in going over the engine and pretending to set the valves, etc. He then left the premises without informing the purchaser of the real cause of trouble, which was unjust and unfair.

He concludes by justifying himself, saying that if he had not deceived the purchaser there would have been a lawsuit, etc. This is not right, for if he had simply shown him that it only required one-quarter revolution of the by-pass valve wheel to provide a complete remedy, he would have been ashamed of his stupidity and been glad to drop the subject and pay the bill in due time.

Some time ago my attention was called to the fact that a certain firm who build a great many steam engines, employ one expert whose principal business is to visit plants where these engines are not properly cared for and show them what the cause of trouble is and explain a remedy for each case. This man is paid a large salary, which he fully earns. Suppose that this place was vacant and W. E. Van Hoose should apply for the responsible and lucrative position. While endeavoring to impress this firm with his fitness for it, would he show how cleverly he could deceive people? I think not, for every business manager worthy of the name knows that if a man will deceive his customers he will deceive the firm also at every convenient opportunity.

My observation of these matters, covering a long period, leads me to decide that this is a rule to which there are so few exceptions that it may be applied universally. Why are men so blind to their own best interests as to ignore these facts?

Suppose that this firm should employ Mr. Van Hoose for this work, and he should travel to many plants disable the globe valves in some, pretend to set the steam valves in others and practice similar deception elsewhere. How long would it be before his transparent tricks would be discovered, bringing both ,himself and his employers into disrepute, damaging the business, and resulting in both moral and financial loss? Not long, I assure you, for people are not so stupid as he represents them to be.

Following the letter above mentioned is one entitled "Another Kind of Deception." This is a mistaken idea for every act of deception told of in these columns belongs in the same class, as they are all of one kind, are properly placed together, and come under the heading "Dishonorable."

In nearly every case where a writer for these columns has told of dishonest acts, he has endeavored to present one or more excuses for them, but readers who have never been "crooked" in their acts are not deceived by such weak arguments, and caused to believe that the adoption of right principles, which has placed them in responsible positions, and kept them there for years, is all a mistake, for it is not and never can be discredited by telling of little, mean, contemptible acts.

A careful review of the list of these acts as presented in these columns does not disclose a single case where deception was necessary, or even where better results were secured than if an honorable and honest course had been pursued.

W. H. Wakeman.

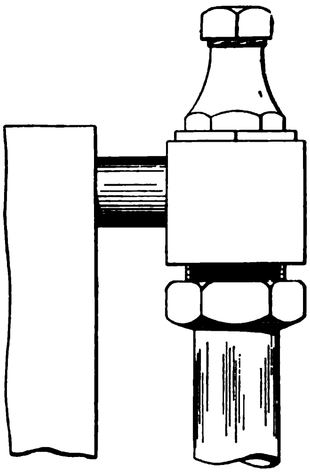
Lubricator Troubles.

Editor of the Engineers' Review:

Some time ago I removed the plug on top of the sight feed glass on one of my lubricators in order to clean the glass. When I got ready to put the plug back, I could not find it. I had to get the lubricator in working order as soon as possible, and as no pipe plug would fit the hole on top of the glass I decided to try the bonnet of an old ½-inch valve which I found fitted nicely. I removed the spindle from the bonnet and cut a blind washer out of a piece of sheet brass to fit over the hole in it. Another washer was cut out of sheet lead to fit the brass washer. The lead washer was then put over the hole, next the brass washer over this and the packing nut screwed over both. When the pressure was put on the lubricator, the new plug did not leak and when the job was done it looked as in the illustration.

This same lubricator started to work badly one day and cleaning it out did not help the trouble any. In a day or two the lubricator refused to work altogether. There was a pump on the cylinder, so I used this the rest of the run. The next morning I disconnected the pipe connecting the condensing chamber to the steam pipe, and found that the pipe which leads from the main steam pipe to the angle valve, was clogged up with scale and dirt so that very little steam could pass through it. After I had the pipe cleaned out the lubricator worked all right.

H. J.



SUBSTITUTE PLUG.

Old Time Engineering.

Editor of the Engineers' Review:

I am getting somewhat along in years, and the way in which engineering is carried on now is somewhat different from what it was when I started in. Some of the enginers who write for the Review touch upon things which happened some years ago, and such letters have lead me to wonder if the experiences of a powder mill engineer would not be at least interesting. By powder mill engineering I mean running an engine where gunpowder is manufactured.

In order that the readers may fully understand the nature of such a position, and what it means to the engineer to be surrounded by buildings which are as liable to explode as they are to hold together, it may be well to state that in the manufacture of gunpowder, the different materials which, while perfectly harmless in their original state, form an explosive when mixed together. As the mills are several in number, each process being carried on in a building by itself, it is easy to see that the mills as a whole occupy considerable territory, especially so since they are located far enough from each other as to be supposedly out of the way of flying pieces in case of an explosion.

In powder making there are two types of mills, light and heavy. The light mills, so called, are those in which the powder is first mixed, and although liable to explosions, are not so liable to do damage as are the heavy mills which handle the powder after it is thoroughly mixed. I have known of a light mill exploding when hardly anyone knew that an explosion had taken place. When a heavy mill explodes there is no doubt as to what has taken place. I have seen the wrecks of heavy mills when there was nothing but a hole in the ground to tell where the building originally stood.

The names I shall use will be fictitious, but the occurrences are true in every respect and will be recognized by those who went through the experiences with me, if these lines happen to come to their notice. Surrounded by such conditions it can be imagined that the engineers were sometimes rudely awakened out of the little catnaps which they indulge in while on duty, especially at night.

The engine room was situated in the midst of these mills. In fact, it might be likened to the hub of a wheel with the end of each spoke representing a mill. The equipment consisted of a Putnam engine, two return tubular boilers, a pump and an injector. As hard coal was burned the job did not require very much hurry on the part of the engineer who did his own firing.

The engine was connected to the different mills by long lines of shafting, running at different angles, and connected by gears. The engine was in a sense direct connected to each mill. One can imagine the shock the engine experienced when one of the mills exploded. It goes without saying that there were some lively times around that engine room first and last.

I remember well the morning of the first instance which I shall relate. It was one of those mornings when persons feel glad that they are living, with the bright sunshine, the invigorating air and all the conditions which go to make up an ideal summer morning. Matters were going along as smoothly as usual when at about 9 a. m. an explosion occured in one of the mills which not only demolished the mill, but broke glass and did other damage to the machine shop, engine room and other buildings.

When these mills explode the first question asked is, who is hurt or killed. Although every explosion does not claim its victim, the chances are so great that it has, that the supposition is that someone has been caught until the contrary has been proved by all the men being accounted for. In this instance, however, the explosion claimed its victim, a man by the name of Naylor, and although he was terribly burned he lived long enough to give a few facts regarding the matter. It seems that he made a visit to the mill and found when he got there that it was "dusting." When a mill is "dusting" it means that the charge has become so dry that it leaves the bed of the mill in the form of dust, in which two 7-ton iron wheels revolve and twist. When a mill has been "dusting" long enough the charge of powder practically all leaves the bed, which allows the wheels to grind on the iron bed-plate, which of course causes them to strike fire and an explosion occurs. This is just what happened in this case, the mill had been left too long without attention and Naylor got to the door as the mill exploded.

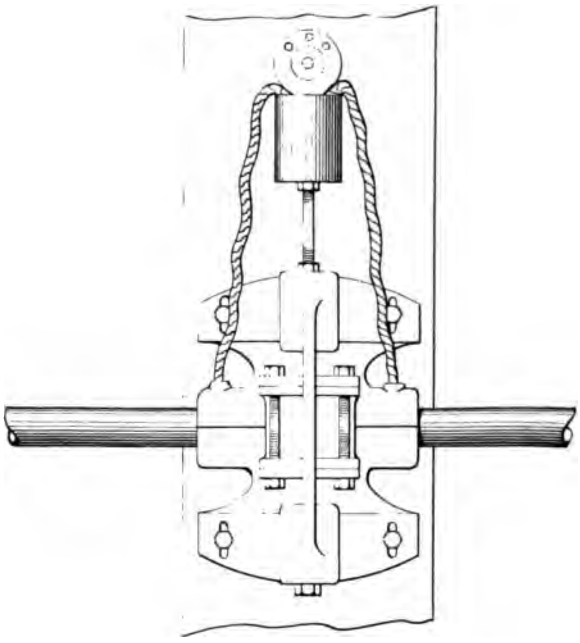
In those days board walks connected one mill with another, over which the powder was wheeled in charge boxes placed on wheels. Although Naylor was badly burned and bewildered from the shock of the explosion, he had strength enough to walk from the wreck of the mill, along this board walk, until he came to the gravel walk of the street. The minute his feet touched the gravel the bottom skin came off, leaving the flesh and nerves bare. The agony this man suffered no one knows until relief came by death, which occurred later on in the afternoon. Old Timer.

Shaft Oiler.

Editor of the Engineers' Review:

Following is the method I use in oiling a line and countershaft. The line shaft is 150 feet long, and by my way of oiling I only have to go over it every two weeks and it saves an hour's work each day. I took a can which was opened at the top and turning the lid back, nailed it to a beam. I then took hemp packing and stretched lengths from the can to each oil hole in the box and filled the can half full of oil every two weeks. The arrangement is shown in the illustration.

C. B. Carson.



CAN AS A SHAFT OILER.

Working Outside the Steam Plant.

Editor of the Engineers' Review:

This question of doing work out of the boiler or engine room reminded me of an experience I had once. I had change of a plant consisting of a 75-horsepower engine and two 50-horsepower boilers. The firm heated a part of the shop with a coal fire. The coal had to be carried up three flights of stairs by a *man of all work*. One day this man was sick and the superintendent came into the engine room thinking that as I had time to sit down and read, I could carry the coal and take care of the fires in this part of the shop, and he ordered me to do it.

I told him I would not leave the engine or boiler room while the power was running, but he ordered me to carry the coal and left me. I gave the fires a light covering of coal, checked the draft, shut down the engine and started to carry the coal. Of course, all the foremen started for the engine to see what was the matter and with them was the superintendent. I was carrying the coal, however, and was not in the engine or boiler rooms.

It struck the superintendent where I was and he started to find me, and of course we had it out right there. Just as the war of words was getting pretty hot, the president of the company came along and finding out what the trouble was, it did not take him long to straighten the matter out. He told the superintendent that the company hired me as engineer and not janitor, and if he could not get any one to carry the coal to carry it himself, but under no circumstances whatever was he to take me away from my work again.

H. Armstrong.

Obeying Orders.

Editor of the Engineers' Review:

Sometimes an order is issued to an engineer which makes him wish he had chosen hod-carrying or grave-digging as an occupation instead of throttle twisting. It may also happen that his orders are in such shape as to be subject to a very liberal translation. In nearly all cases when anything goes wrong, the engineer usually gets the blame, whether he obeyed his orders to the letter, or followed the dictates of his judgment.

I once knew an engineer who operated in a plant where it had been customary for every Tom, Dick or Harry to tell him to shut down whenever anything went wrong. They had a long line of shafting with loose pulleys overhead and sometimes the belts would act as though they were about to pull down the shaft. On such occasions somebody would run to the engine room door and shout, "Shut her down, Jim," and Jim would promptly obey, giving all hands a nice little rest while the machinist looked things over. This occurred so habitually that the superintendent said to Jim: "In the future you will take no orders to shut down except from myself. If anybody here is so nervous they can't stand the sight of a flapping belt without wanting to shut down the plant, they can go home and stay there."

Things progressed nicely after this order became known and the old belts took their flapping streaks unheeded for a week. Then one extra busy day the belt threw a half hitch over a bracket corner and the shaft started doing great stunts. One of the oldest men who happened to be as bald as on the day of his birth. rushed to the engine room yelling, "Shut her down. Jim; shut her down!" Although the racket was audible in the engine room, Jim merely glanced up from his paper and nonchalantly remarked, "Can't do it: against orders." At that moment the superintendent rushed in and giving Jim a look that was intended to melt the buttons off his overalls, yelled, "Close that throttle. Why didn't you shut her down?"

"Mr. Shove," replied Jim in his oiliest voice, "don't you remember your positive orders to me to shut down only on orders from yourself?" "Orders be blanked," said Mr. Shove, "you ought to use a little common sense. Couldn't you tell something was wrong when you saw this man rush in here so scared his hair was standing straight up?" For an answer Jim walked over to where the old man was silently taking in the scene, removed his hat and indicating the shining pate with an expressive gesture, and glanced at the superintendent with a puzzled and innocent stare. Mr. Shove walked away with an effort towards maintaining his dignity, and Jim is engineer of that plant today.

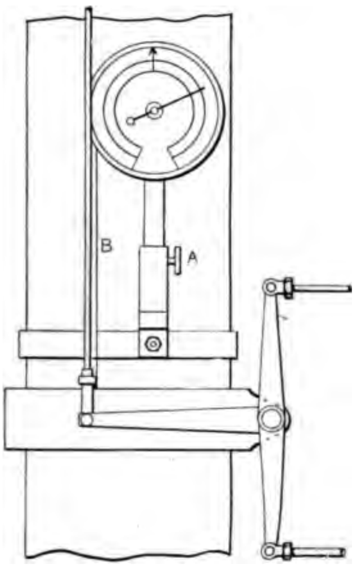
Brick Eater.

Horsepower Indicator.

Editor of the Engineers' Review:

The following is how I made an indicator to record at all times the power my engine was developing.

I took an old screw watch case and made a grooved wheel to go inside of it to take a small cord which is wound about once around the wheel. The cord is attached in the groove. There is a watch spring on the back of the wheel supporting the pointer, shown in the illustration. This watch spring is attached to the wheel in order to take up the slack from the cord line so that when the governor moves, the hands on the gage which are fastened to the pinion of the grooved wheel will move.



HORSEPOWER INDICATOR.

There are two hands. One can be for high and the other for the low pressure cylinder or one may be used to see when the engine cuts off. In making the gage mark on the dial when the indicator card is taken, the horsepower can be taken on the dial. *A* is the adjusting screw for adjusting the gage. *B* is the cord.

A. L. Johnson.

"Know-It-All" Engineers.

Editor of the Engineers' Review:

He came, he stayed awhile and went away. I refer to one of those engineers who know it all. He came in the other day, he carefully scrutinized the plant and expressed his opinion on about everything he saw, not failing to give me his opinion regarding Smith and Jones, down street, and several other engineers in the town.

The first thing he saw was a small leak in the steam pipe joint which is in use day and night and Sunday, whereupon I received a lecture on the waste of escaping steam and dripping water, together with a list of the serious results which might occur if such conditions were allowed to continue. There wasn't much about the plant that seemed to be working as it should, although I had thought before that I was getting pretty good service out of it. He gave me the tip on the quiet that he had operated about every type of engine built and that none of them had ever made as much noise as mine did. This surprised me a little, because I knew he had never held a job for any length of time, but somehow or other he was always able to get a new one, but whether he got anything for it in the shape of salary is another thing.

This fellow's visit makes me think of an engineer I had running for me on the night turn sometime ago. He was one of those fellows who knew more or less about engineering, according to the way you want to look at it, and had a great faculty for monkeying with things after I had gone home at night. This is something I objected to very strenuously, because I do not believe the engine is made that can stand being operated on by two men, especially when each has a different opinion regarding certain things. Finally we had it out one night and he got it good and straight that if he wanted to continue as night engineer he would have to stop tinkering with the engine, although I was ready to listen to any suggestions he had to offer. This settled the matter as long as he stayed with me, which was only a few weeks, when he left to take another position.

A. Knowitall.

Give Firemen a License.

Editor of the Engineers' Review:

The editorial "Should Firemen be Licensed?" brings up a subject which is of more than passing interest to the engineer as well as to the fireman. It is beyond my comprehension how a body of engineers can get together and argue themselves into the conviction that it would be a great calamity to allow a law to be passed licensing the firemen of Ohio. The matter resolves itself into the fact that the engineers seem to be afraid that the firemen will get along, and in some instances take their place. This to me is a rather childish way to look at the matter.

If licensing the firemen is going to make them more capable than the engineers, it is time for the engineers to brace up and show that they are fit to have charge of the plant! The argument that the firemen will assume charge of the boiler room is all bosh and a sensible man will not think about the matter twice after he sees how ridiculous it is. I am a N. A. S. E. engineer, but I have no shivers running up my back worrying over my fireman getting a license, but will help him all I can to get one.

The question as to who will have charge of the steam plant is not a new one. The same thing has been agitated before, only the difficulty was as to whether the engineer was to have charge of the steam plant or the superintendent. Without doubt there have been many instances where the superintendent of a shop has dic-

He finally approached me and asked if I had an indicator. Now I will say that this happened when I was young in the engineering business, and did not know much about that instrument. I told him I had and went and got him my speed indicator. I saw that he looked at me rather surprised, and then in a manner not in keeping with his appearance he explained to me what kind of an indicator he meant, and told me that as he was making some repairs in a neighboring plant he would gladly assist me in taking a card off my engine if I wished.

Of course I was willing and became quite interested in my new friend, especially as he thought he could locate and remedy the annoying pound, which I could not find. After he had fixed up and was ready to take a card, I began to realize that in my short experience as an engineer, I had yet to see and learn of the usefulness of the indicator, and was grateful for the information I was obtaining.

After he had taken several cards and made some changes, that mysterious pound had disappeared. He found that I had too much compression in one end of the cylinder. My strange visitor had opened up another world to me in the engineering line, and I was not long in getting an indicator and book of instructions, and soon found that the speed indicator which I had was not the only kind.

The moral of this is that we cannot always judge a man by his looks. G. B. W.

Engineer was not a Fireman.

Editor of the Engineers' Review:

In the July issue of the Review, F. H. King says: "I do not believe that a man who knows nothing about boilers could get a position as an engineer." I must say that I have known of just such cases. A man learned the machinist's trade and worked in a shop where engines were built and after becoming thoroughly familiar with that make of engine, secured a position as chief engineer where five of these engines were installed. He was a good engineer, capable of making all repairs, but when it came to the boilers he frankly admitted that he had never seen the inside of one. Was that man competent to handle steam and to tell the fireman what he should do and how much pressure he should carry? I think not, and I do not believe others will.

Mr. King does not advocate connecting boilers with a difference in pressure of 35 pounds, but he says it is no more than "other engineers do, who are supposed to know things." That does not make it any the less dangerous. If one man makes a mistake or does a foolish act, I do not think we should all follow his example, even if he is a learned man. M. E. Webber.

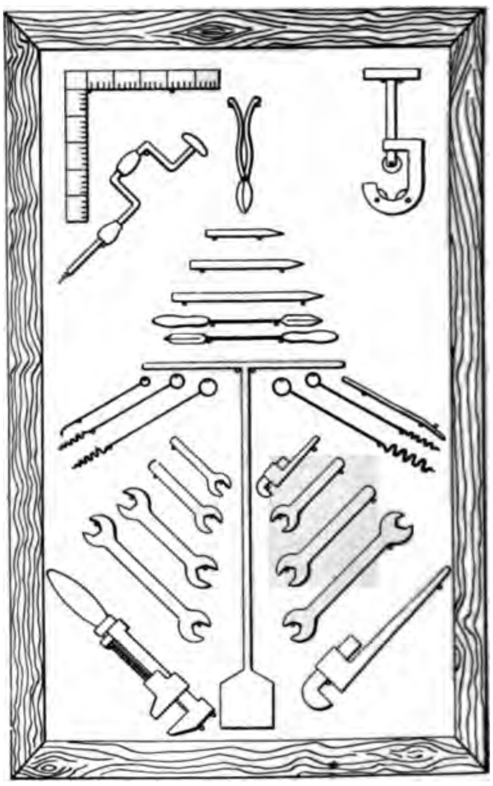
Touches on Several Subjects.

Editor of the Engineers' Review:

Perhaps the way we oil our engine would be of interest to engineers who have not used an oiling system. First we have our filter about 2 feet above the cylinder and use ¼-inch brass pipe to distribute the oil to the different bearings. The engine bed is also piped into a 5-gallon can which makes oiling hardly any trouble at all. No doubt iron pipe would carry the oil all right, but, of course, it would not look so nice.

There has been some talk on dynamo dressers an how to make them, so I will tell how the one we us is made. It is about 2¼ inches in height from the cen ter of the curve to the top, 3⅝ inches wide and 2 1- inches long, running lengthwise of the commutato This is for one machine, but could be made longer fo incandescent machines.

A few nights ago the babbitt on one of the cross head shoes came off. When we examined it we foun that only 4 holes out of 12 were filled in the casting



TOOL BOARD.

We had been troubled with an annoying knock fo some time and when we put on another shoe it seeme a great improvement.

Now I want to do a little knocking. A former en gineer took the same shoe off and tried to babbitt it, an as is plain made a muss of it. Before he monkeye with it I think the shoe was all right as we found tha the outer pillow block was ¼-inch lower than th others and the cylinder rings were loose when on th engine they should have been tight (endwise).

The illustration is of our tool board. L. S.

Is Firing Necessary to Success?

Editor of the Engineers' Review:

I see "Mij Mils" and "Slim Jim" are also of th opinion that the boiler room is beneath the chief en gineer's notice, and that he has nothing to do with th part of the plant as far as superintending the firin is concerned. I fail to see where either of them mak much of a point. I did not say that the chief engine should spend all of his time in the fireroom, instructin the firemen how to do their work, or shoveling co hes, but I do say, he should know how to instruct . If he has a head fireman he should give him his ictions, and he should instruct the other fireman. e seen plants that worked six firemen and none em had had more than a week's experience except ead fireman. Suppose he should drop out, who ing to superintend the work? There is a hundred ne things that come up in every day life that one l mention that convinces me that the chief engineer d understand firing.

is very true that there are chief engineers who are ssfully holding their positions, who never fired a in their lives, but they have assistant engineers do that part for them.

t long ago, a friend of the writer had charge of ft in the largest plant in this city, and on one ion they got an unusually heavy load, and the fire- was unable to hold the steam. The chief engineer l him up by phone and asked what was the matter, he replied that the fireman could not hold the . The chief then wanted to know why he didn't the fireroom and give them instructions and see hey did hold the steam up. He replied that there head fireman down there who was supposed to after that part of the work, and that his work n the engine room and the engines were all right, ey lacked was steam. The chief informed him if he was not capable of finding out what the le was, as he knew the boilers were of ample ity to handle the load, that he would have to put a there who could do the work. And as he had had any experience in firing, the consequences he lost his job. Of course, the chief held his but the second engineer suffered for what they d in knowledge in the fireroom.

m still convinced that firing is necessary to suc-

Slim Jim.

Firing and the Engineer.

r of the Engineers' Review:

ere has been some discussion recently in the w on the question of experience in the firing of s, as a necessary part of an engineer's training. me of the boys seem to have a poor opinion of eers who have not worked up through the boiler . This, to me, appears a very narrow view to

hink all Review readers will agree that the men arge of the machinery of all the great Atlantic are *fairly good* engineers, yet few, very few in- have been firemen. In fact the British rules t make it compulsory for a man to be a machinist, reroom experience is not demanded.

e United States law requires that to obtain a e, a man must have served at least three years oiling or firing on a steamer, but if he is a inist one year is deemed sufficient. I might add n the lakes when a young machinist goes steam- g he commences as an oiler.

great number of the smaller craft in both the sh and American navies are in charge of ma- ts, there being always a scarcity of engineer s to cover the field, and these machinists do work successfully, yet without actual firing ex- ce.

this town where I am holding a job, when I look d and note the engineers who are holding the most prominent positions and drawing the highest salaries, I find that nine out of ten are machinists. There are four city pumping stations here and one being built. In charge of these for the past 20 years or more, has been a chief engineer who is a machinist and his 13 assistants are all machinist engineers.

There is, in my opinion, no foundation for the idea that a man must have actually fired to make a good engineer, or that a machinist, as a rule, makes a poor one. Shop experience is quite a help and boiler room experience is not to be despised.

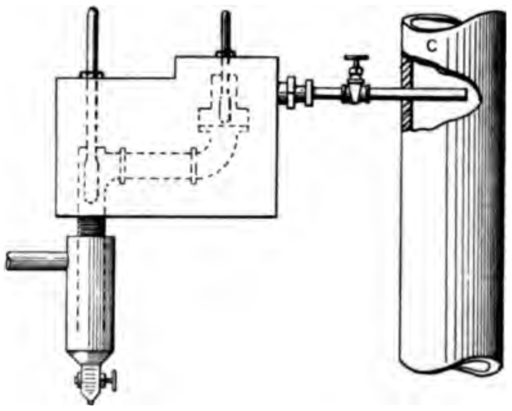
As the editor remarks, I don't think any of the boys will be troubled or feel aggrieved at any of Mr. Philip Dase's statements, his letter was rather amusing. I hope he will think twice before dropping his paper. Others of us who do not pretend to know it all find much interesting and instructive reading in every issue of the Review.

Turbino.

Throttling Calorimeters.

Editor of the Engineers' Review:

I am under the impression that there are several of your readers who do not understand how the ordinary throttling calorimeter of two thermometers is used and how the calculation as to the moisture in the steam is made from it. The idea is to get the moisture in the steam so that the operator can determine the quality of steam his engine is using. Many times this information if it were so that the engineer could obtain it would relieve him of considerable trouble brought about by wet steam.



THROTTLING CALORIMETER HAVING TWO THERMOMETERS.

In passing steam from the boiler to a steam engine, it is of necessity wire drawn to a greater or less degree, much of which depends upon the piping, both as to size and the manner in which it is put up. When steam is wire drawn from a higher to a low pressure it liberates heat. If the steam is dry at initial, this heat goes to superheat the steam. The superheat is, therefore, a measure of the amount of moisture in the steam.

In the illustration is shown a throttling calorimeter. The steam passes from the main steam pipe *C*, through a throttling disk having an orifice about 1-16-inch in diameter. The pressure and temperature is measured on each side of the disk, and the quality of the steam determined by the following formula:

$$W = 100 \times \frac{H - h - K\,(T - t)}{L}$$

in which W equals the percentage of moisture in the steam, H equals the total heat, L equals the latent heat of the steam in the main steam pipe, h equals the total heat due to the pressure in the discharge of the calorimeter which equals 1,146.6 at atmospheric pressure, K equals the specific heat of superheated steam. T equals the temperature of the throttle and superheated steam in the calorimeter, t equals temperature due to pressure in the calorimeter which equals 212 degrees at atmospheric pressure. Stanley Howard.

Electrical Conveniences.

Editor of the Engineers' Review:

In nearly every plant where an engineer is required, electricity is used for light, power, etc., and as numerous troubles are likely to arise the simplest kinks are many times the best. The writer has found that a handy and reliable way for testing incandescent lamps before replacing the burnt out ones, is made as the illustration, Fig. 1, shows. It is screwed on the wall or in some convenient place and is nothing more than a cutout block, properly wired with terminals. The two plugs are bridged at *L* and *M*. The upper plug fitting is taken from the block and placed on the end of a pipe and hammered so that the threads are flattened to do away with the inconvenience of screwing the lamps into the socket. By this method all that is required is to simply press the lamp in the socket, when the contact is made. It is therefore easily determined whether the lamp is good or bad.

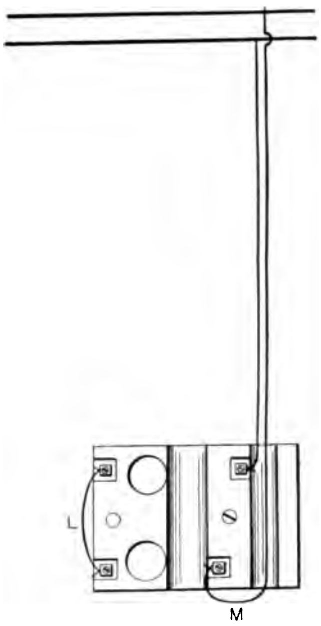


FIG. 1. FOR TESTING INCANDESCENT LAMPS.

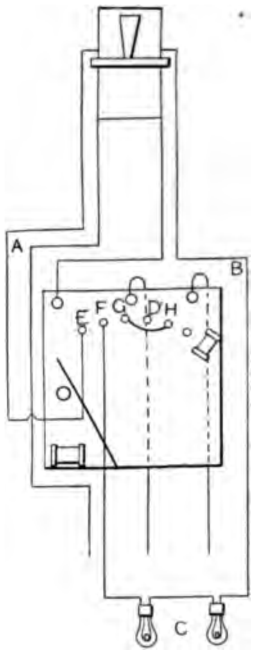


FIG. 2. TEMPORARY REPAIR TO STARTING BOX.

Considerable difficulty is sometimes encountered when a starting-box fails and an immediate remedy to locate the trouble is often desired, especially if a
porary repair can be made. I have accomplishe
with success. In case one or more of
contact points are dead or in other words
resistance wire leading to them is burned
attach two wires *A*, and *B*, Fig. 2, at the s

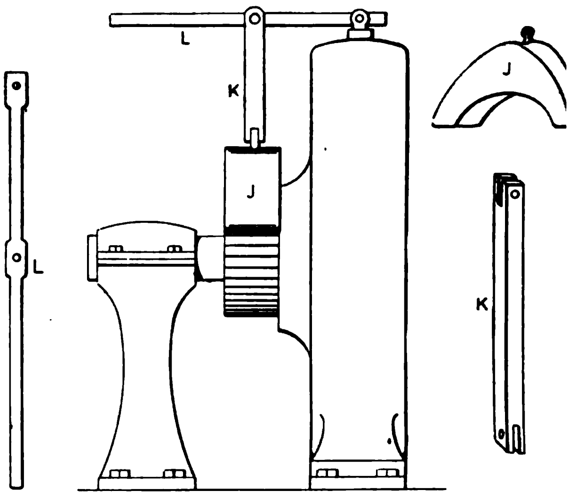


FIG. 3. METHOD OF TRUING UP A COMMUTATOR

with one or more lamps in the wire *B*, as at *C*.
posing there are 250 volts in the line, then two
volt lamps are required to be wired in as shown.
dead point in the starting-box, we will say, is a
If we hold the ends of the wires *A* an
on the contact *E* and *F*, the lamps will light

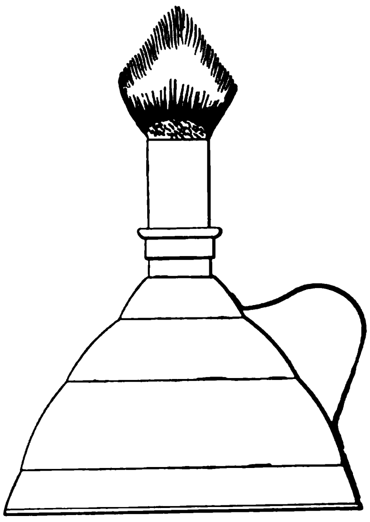


FIG. 4. A HANDY TORCH.

Next place the wires on *F* and *G*, with the same r
but when contact with *D* is reached the lamps
fail to light. Then the wire *A* must not be m
while the wire *B* goes on to the next one unti
lamps shows the circuit is made. To repair this
porarily attach a piece of wire at *G* and *H*,
makes a bridge and *D*, will be cut out. On som

this arrangement has saved the machines from .le except for a few minutes.

llustration Fig. 3 shows how we true up the ators on our dynamos. *J* is a block of wood the idth as the commutator with a corresponding nade to fit the same, having sandpaper pressed ircular form to fit the block, and is then tacked)utside at the ends. A hole is drilled through k for the brush holder to pass after the brushes en removed. This is to prevent the block from :ally falling out of place. A piece of wood is ce *K*, and secured to the block with a bolt and nanner it is attached to the rod *L*. The eye-emoved from the top of the dynamo and a bolt : the same size, with a slot in the end, also a e, to secure the rod *L* in place. The same at-it is used on top of the block. When the is in rotation, it will only be necessary to press y desired degree of force upon the end of the A thorough job can be done this way and)rth trying.

ι handy and serviceable torch to have around, be made in a short time, as shown in Fig. 4, ıg a hack saw or file and cutting off the spout rdinary squirt can about 1½ inches from the ι handle can be made with a piece of tin formed per shape and soldered to the can.

Jas. G. Sheridan.

A Serious Joke.

ɔf the Engineers' Review:

)utcome of a "joke" perpetrated by employes of :ional Tube Co.'s plant, Youngstown, O., last ·, according to the allegations, has terminated dictment for manslaughter, John Fell, engineer 'lant, having been arrested.

employes of the plant connected up a railing dynamo. Geo. Boere looked in to see the time dropping dead when he touched the metal A thorough investigation resulted in the in-.t. Such jokes do not pay.

C. H. Nove.

Safe Speed for Cast Iron Wheels.

ɔf the Engineers' Review:

numerous instances of cast iron wheels of dif-liameters exploding, as reported recently, are : than passing interest to engineers, as they are in the room where the greatest danger of wheel)n exists. In the case of flywheel explosions the <erts a radial force acting on the rim of a wheel en the speed increases sufficiently, this radial ırsts the rim, the force acting from the center ; the circumference. The force tending to burst of a flywheel increases with the square of the therefore doubling the speed quadruples the :ting on the rim.

question that interests engineers regarding the l is not so much its use in preventing sudden ions in speed, but rather what is the highest t which it may be safely run, because we know a danger limit for every wheel, regardless of)unt of material it contains. It has been stated ≥ in a position to know that for cast iron wheels ıarily constructed a rim speed of a mile a min-ıe limit of safety. Following is a table stating nber of revolutions per minute, for cast iron wheels from 1 to 30 feet in diameter, at which the danger limit of 1 mile per minute is reached. This table, I think, was originally gotten up by Mr. Boehm of the Fidelity and Casualty Co.:

Limiting Safe Speed for Cast Iron Wheels.

Diam. of wheel in feet.	Danger limit, rev. per min.	Diam. of wheel in feet.	Danger limit, rev. per min.
1	1680	15½	108
1¼	1344	16	105
1½	1120	16½	102
2	840	17	99
2½	672	17½	96
3	560	18	93
3½	480	18½	91
4	420	19	89
4½	373	19½	86
5	336	20	84
5½	305	20½	82
6	280	21	80
6½	258	21½	79
7	240	22	76
7½	224	22½	74
8	210	23	73
8½	198	23½	72
9	189	24	70
9½	177	24½	68
10	166	25	67
10½	160	25½	66
11	153	26	65
11½	146	26½	63
12	140	27	62
12½	134	27½	61
13	129	28	60
13½	124	28½	59
14	120	29	58
14½	116	29½	57
15	112	30	56

The above table will be found useful in determining whether or not a wheel of a given diameter is revolving at a speed which is dangerous, and also for giving an engineer something to work from in order to know just how much the speed of an engine can be increased if it is desired.

Herbert Hiser.

Linemen Meet Death in a Peculiar Way.

Jesse Donahue, of Minneapolis, and Harry Ripson, of Cuba, Mo., members of a gang of telephone linemen constructing a line between St. Paul and Stillwater, Minn., were electrocuted Sunday, Oct. 1. Ripson was at the top of a cable pole holding one end of a measuring tape, while Donahue, on the ground, held the other. The tape line was of linen, but had running through it two slender wires. It came in contact with a heavily charged power cable and both men received the full force of the current, killing them instantly. Ripson fell from the top of the pole and his neck was broken.

Blame is Fixed.

Responsibility for the accident on the New York elevated railroad Sept. 11, in which 12 persons lost their lives, was fixed by a coroner's jury upon two men. Cornelius A. Jackson, the towerman, who set the wrong switch, and Motorman Paul Kelly, who drove his train around the curve with a speed which caused one car to jump the tracks into the street, were both charged with criminal negligence. Jackson was arraigned before the coroner and released on $5,000 bail. Kelly, the motorman, has been missing ever since the accident.

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STEAM TURBINE TESTS.

Discussions regarding the probable deterioration of steam turbines after being in service for several years, and the probable effect of service on the steam economy of the turbine, have occupied considerable space in the technical press of late. A recent test of a De Laval steam turbine of 150 horsepower, which has be operation for about two years at the plant of the England Structural company, East Everett, M throws some light upon this question, and an exa tion of the turbine has shown that the wear on all was practically nothing.

The manufacturers' guaranteed that with 150 p of steam pressure at the governor valve, and inch vacuum at the turbine, that 18.7 pounds of per brake horsepower per hour at full load wo consumed, and 19.7 pounds of steam at half These figures compared with those obtained fro test show that the machine after two years of s was well within the manufacturers' guarantee. test developed the fact that with a boiler presu 152.9 pounds of steam, and with a steam press 145.9 pounds below the governor, and a 25.4 vacuum, the steam consumption per brake horse was 17.77 or .07 pounds greater than when the tu was first installed, but the vacuum and steam pre at the governor were lower.

Another recent turbine test was that of 2,00 owatt Curtis, which was built in 1903 for the monwealth Electric Co. of Chicago. This turbin of the four-stage type, but conforms as nearly as ble to the four-stage machine now built, due to ch which have been made upon it, although it is les cient than the newer type which is now in use. U such conditions with a steam pressure of 166.3 po gage, superheated 207 degrees F., and a back pre of 1.49-inch of mercury, at full load, the steam sumption per kilowatt hour was 15.02 pounds. half load the steam consumption was 16.31 poun steam per kilowatt hour, with a steam pressu 170.2 pounds, back pressure 1.40-inch of mercury steam superheated 120 degrees F.

For quarter load with steam at 155.5 pounds, s heated 204 degrees F., and a back pressure of inch of mercury, the steam consumption was pounds per kilowatt hour.

The steam consumption per hour at zero load 1,510.5 pounds with a steam pressure of 154.5 po back pressure 1.85-inch of mercury and surperh 156 degrees F.

It will be noted that one test gives the steam sumption per brake horsepower, while the other i kilowatt hour. Both are tests worthy of atte The above figures which are those obtained with fully tested measuring instruments, are rather vincing proof that the efficiency of the steam tu is not impaired through constant and extended s although many predicted that it would be.

CARNEGIE'S LIFE OF JAMES WATT

Mr. Andrew Carnegie—once a stationary firem has written a life of James Watt. No one wh read the several books from the hand of the fa ironmaster can, it seems to us, feel that Gladst sneer at the Scot's authorship was justified. Hi of Watt is a very readable volume. It abounds poetical quotations, references, citations, allusion teresting comment and digressions in which Mr. negie reiterates some of his well-known opinion was evidently a labor of love. If William Mo definition of art is correct, *i. e.*, that it is the ex one's love of his work, this book is a work

tory of the life of James Watt is, in the main,
.own—his frail health; meditative, studious
his enforced entrance into his father's shop at
k, due to financial reverses; his apprenticeship
lon to a mathematical instrument maker; his
ıing himself in his trade at the University of
r; his exhaustive labors in improving the New-
ngine found at the university; his heart-break-
.s while experimenting upon, constructing and
his first two engines; his final arrangement
·tnership with Boulton; his long siege in con-
with the problems of poor tools, poor workmen
judice; his hardly less annoying experience in
g patents; his final triumph and the peaceful
a life as strenuous as the most hustling Ameri-
ld wish. This absorbing narrative is given in
·able detail, without attempting a technical ex-
of the mechanics so deeply involved in the
k of the most famous inventor of the world.

; Watt is a never-ceasing inspiration. The
ırshiping vein in us need not be guarded against
:udying him, for fear of estimating him above
: worth. No more noble character has ever
with the problems of progress. Biography can
ıusted in the effort to find a man whose life
rk can be more profitably studied by all—boys,
nen, middle aged men and old men.

was a lad that poesy seemed to claim for its
ı pensive, so in love with nature, so charmed
ʒendary lore in which his native land was so
delicate anaemic boy unable to romp and tear
·ith other boys, but relegated to a soft seat in the
/here the companionship of his mother and his
/ere his all. But he liked handicraft as well as
ıatics and natural philosophy. That is why he,
ssessed one of the brightest minds of the age,
complain when set to making compasses in his
shop. He did not call it menial. He loved it.

t a lucky fellow was this Jamie Watt, thinks the
-well who begrudges every hour he must spend
.ng an existence; how carelessly he stumbled
engine lacking all modern improvements at a
ıen mines were being abandoned because horses
ıot keep them pumped out and a better me-
l horse was in demand. The believers in luck
the only ones who don't appreciate the marve-
lmost unexampled thoroughness with which
.thematician and mechanical genius approached
at task. No savant who has made his name a
the first magnitude ever delved with more pains-
patient care, followed every possible lead more
nindedly in his empirical inquiry, or ever sought
·eater zeal the first cause in a work to which he
:dicated himself, then did the progenitor of
ɜngineering. Newcomen's was an engine only
ɜ. It hardly did more than Hero's toy nearly two
ıd years earlier. Atmospheric pressure was all
, and to return the piston to the upper end of the
r was all the work it did, the power being de-
l by gravity, on its descent. The young instru-
ıaker might have been a very god of genius as
.anic without being able to make it do practical

The comprehensiveness with which he took hold of the task is shown by his turning his attention first to the source of power—the steam. Nothing was then known of steam except that it is a gas formed of water under a certain temperature. Watt's discovery of the properties of steam is as important as his discovery of the conditions necessary to the development of power in a steam cylinder and the means to meet those conditions. The existence of latent heat was first proved by him. It was an original discovery, although his friend, Prof. Black, had, unknown to him, taught his class the probability of such phenomenon. Then followed his determination of the total heat of steam. These are among the most important discoveries in physics. The world was ranged for knowledge contributary to the subject. How many men who read this are pursuing investigations with so much zeal that they will learn three languages simply to help them get facts first hand? In the French, Italian and German tongues some of the best work along the line Watt was studying had been recorded. There being no translations, this indefatigable young man who was plagued with headaches, set himself to learning them—and succeeded, of course. Somewhat the same patient, dogged unflagging spirit was shown by Edison in his hunt for a material for the filament for the incandescent lamp. Could nature keep her secrets hidden from such tireless seachers? Similar quest has been made, and is now being made, by scientists to learn the ultimate nature of matter-what the stuff is in itself of which we and all things are made, what light is, what electricity is, what life is. But among the first men of science who bent all the energies of their minds to their work of discovery with singleness of purpose exceeded by neither saint nor sage, was James Watt.

The disheartening lack of tools and materials and skilled men that Watt encountered would have baffled any man other than the undiscourageable genius of Greenock. No machine requiring such precision had ever been attempted before. It was years before he was able to get a piston to fit fairly tight in the cylinder—not until a cylinder boring rig had been devised by a foundryman.

Watt was a tireless reader, experimenter and thinker. He not only invented the machine that has changed men and the world's face more than any other agency that can be named, but he did another thing that alone would place him in the galary of the immortals—the discovery of the compositions of water. He invented also many useful small things—the letter copying press, the best lamp of his day and a cloth drying machine. He was also a well-known surveyor and engineer.

All men cannot have the head that rested on Watt's shoulders. The versatility, the insight into human nature of a Shakespeare or into mechanical and physical science of a Watt, does not come by culture. But all can follow the example of his marvelous industry and devotion to the work in hand.

It does one world of good to know a hero off the stage. The gallery is full of statues of the great, but like Venus of Milo they are mutilated somewhere. Here is one entirely great and good. His splendid head was matched by a splendid heart, and his life was filled with honor as a man, as his name is encircled by the nimbus of fame.

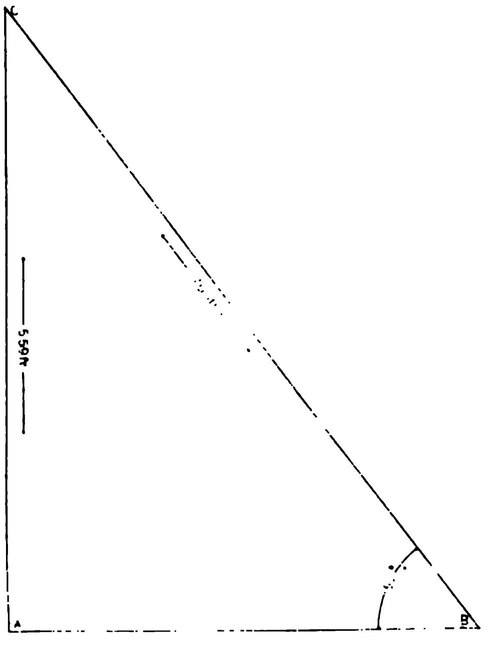
QUESTIONS
·OF THE HOUR·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.

The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

---

(452) P. H. M., Black Diamond, Wash. Q.—"I have a pump which is delivering water up a hill a distance of 700 feet at an angle of 52 degrees. How can I determine the vertical height from the pump level to the point of discharge?" A.—A method that will answer as well as any will be to strike out a diagram, as shown in the illustration. Draw a horizontal line *A B,* to represent the level of the pump, and with a protractor on the base line draw a line through the point denoting an angle of 52 degrees. Then with a scale used in measuring indicator diagrams, say a 60 scale, measure off 700 feet on the diagonal line *B C,* and draw the vertical line *C A.* With the scale measure the distance from *A* to *C,* which in this case will be 559 feet. As a column of water 1 foot high is equal to a pressure of .434 pounds, to find the pressure in the pipe at the pump, multiply the height of *A C* by .434, or 559 × .434 = 242.6 pounds pressure. If a 60 scale is not at hand, a scale divided into forty-eights will answer, each ¼-inch being divided into 10 divisions and if each is figured as 1 foot the height of the vertical line is easily found by measuring with that scale, and at the same time keep the diagram at a reasonable size.



FINDING THE HEIGHT OF THE POINT *C* ABOVE *B.*

(453) E. B., Okanagan Landing, B. C. Q.—"What does the term 'nominal horsepower' mean?" A.—A *nominal* horsepower may be said to exist in *name only. It is not* real and does not mean anything in particular. It corresponds to the expression such as "large as a lump of coal," or "as long as a piece of rope."

(454) Same. Q.—"What is the horsepower termed which is available for doing actual work after the frictional horsepower has been deducted?" A.—Every engine has more or less friction and the power absorbed in overcoming this friction, or the power absorbed by the engine itself, is termed frictional horsepower. The frictional horsepower subtracted from the indicated horsepower, which is obtained from an indicator card, is the power available for doing useful work and is termed the net or actual horsepower. It can in no way be construed to apply to nominal horsepower as some engineers think.

(455) Same. Q.—"What is the meaning of elongation? Does it not mean the stretching of say boiler plate, lengthwise?" A.—Yes.

(456) Same. Q.—"Is there an engineers' dictionary published?" A.—We do not know of any engineers' dictionary. The nearest approach to it are the handbooks treating upon engineering subjects, which have more or less definitions of engineering terms.

(457) T. W. H., Monroe, N. C. Q.—"I have a Lane & Bodley Corliss engine, size of cylinder 22¼ x 48, running at 70 revolutions, having a flywheel 16 feet in diameter. The engine is belted to a shaft having a pulley 4 feet in diameter. The engine is developing 264 horsepower with 95 pounds of steam. We want to develop 330 horsepower. Can I increase the speed of the engine enough to get the additional power and at the same time increase the size of the shaft pulley? If so, will you figure out the speed the engine must run to develop the 330 horsepower required and the size of the shaft pulley to run the shafting at the same speed at which it now runs? I think I may be able to carry 100 or 105 pounds of steam, but no more." A.—The maker's rating of the Lane & Bodley engine having a cylinder 22 x 48 inches, operating with a steam pressure of 100 pounds and making 85 revolutions per minute, is 335 horsepower, cutting off at 1-5 stroke; 400 horsepower cutting off at ¼ stroke and 656 horsepower cutting off at ⅝ stroke. By increasing the speed of your engine 13 revolutions and carrying 100 pounds steam pressure you will obtain the required power. The shaft is running 288 revolutions per minute. This is found by multiplying the revolutions of the driving pulley by its diameter and dividing by the diameter of the driven pulley. Thus: 72 × 16 ÷ 4 = 288 revolutions. In order to find the size pulley to put on the line shaft with the engine running 85 revolutions per minute, multiply the diameter of the driving pulley by the number of revolutions and divide by the speed of the driven pulley. The answer will be the size of the driven pulley. We have, therefore, 85 × 16 ÷ 288 = 4.7 feet or 4 feet 6.6 inches.

458) J. A. R., Santa Rosa, Cal. Q.—"How is the pitch of a gear found if the gear has eight teeth for each inch in diameter?" A.—Supposing the gear is 12 inches in diameter, if eight teeth are allowed for each inch in diameter there will be 12 × 8 = 96 teeth. The pitch of the teeth are found by dividing the product of 3.1416 and the diameter, by the number of teeth. The pitch equals 3.1416 × 12 ÷ 96 = .3927 inch, pitch.

Canal Boats to be Driven by Turbine Engines.

The improvement of the northern division of the Ohio canal has resulted in a contract being let to the Coen Vessel Co. of Atlantic City, N. J., for the construction of 320 canal boats of steel.

This announcement was made recently by C. M. Coen, president of the Coen Co. The company will manufacture the boats and also manufacture turbine engines after the boat contract is completed. It is claimed for the turbine engines to be used that they occupy little room in the boats, and do not displace freight. The new style of vessels are intended for freight only.

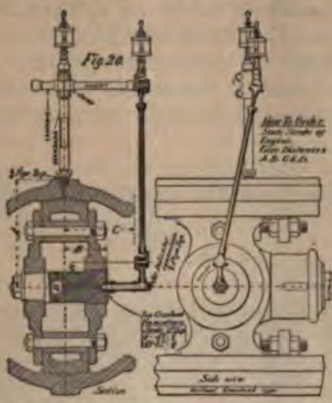
Caught by Belt.

James Ross, aged 24, an Italian laborer at a paper mill located at Steubenville, O., was killed recently by being caught by the flywheel belt. He was whirled around the small wheel and then hurled against the big flywheel, and next against a brick wall, dropping lifeless into the wheel pit.

THE NUGENT TELESCOPING CROSSHEAD PIN OILER.

The Nugent anti-packed telescopic oiler, which is shown in the accompanying illustration, is designed to lubricate any reciproating bearing such as the crosshead pin, eccentrics and double disk crankpins of steam engines and other similar bearings.

The anti-packed joint is the new, novel and improved feature of this invention. The joints are 1-100 of an inch loose and yet not a drop of oil can leak or waste through them. They have no stuffingboxes, washers or packing of any kind. Thus the friction, wear and jar is practically done away with, also all unsightly braces or guy rods. This device will outwear the engine or piece of machinery to which it is applied.



NUGENT TELESCOPING CROSSHEAD PIN OILER, SHOWING SECTIONAL AND SIDE VIEW OF THE CROSSHEAD.

This oiling device forms a continuous conduit or channel for the oil from the stationary oil cup to the bearing which is to be lubricated. It is stated that it will about treble the life of the crosshead pin, which usually wears out as fast again as the crankpin. It will save its cost in oil in a short time over any other appliance. It enables the engineer to know positively whether or not the bearing is getting oil and it places the pin or bearing under his absolute control at all times and enables him to run his engine continuously for years, if necessary, without having to stop to replenish the oil. By simply pulling out two cotter pins with the fingers, the telescopic tubes and heads may be removed in a moment's time.

The purchaser of this appliance takes no chances whatsoever, for perfect satisfaction is guaranteed and purchase money will be refunded any time within one year from purchase date if the oiler does not fulfill expectations. Any further information about oiling devices which may be desired will be gladly given by the manufacturers, Wm. W. Nugent & Co., 28-30 W. Randolph street, Chicago.

The same firm manufactures special oiling devices for the crankpin, eccentrics, center crank engines, lower shoe of the crosshead and loose pulleys. They also issue a valuable treatise on "How to oil an engine" which will be sent free of charge to any engineer or owner of an engine, requesting it. It contains a lot of good pointers gathered by Mr. Nugent from practical experience while running, erecting and manufacturing engines.

THE ANDERSON PATENT ALTITUDE VALVE.

A great deal of difficulty is being experienced by railroads with water regulating valves failing to properly maintain a uniform stage of water in the supply tanks along the road. This is especially true in the Northern States, where extreme cold weather adds its complications.

The general method in use at present is the ordinary float valve inside the tank.

The principal difficulty with this arrangement is that of having the float become water-logged or lodged in the ice, which immediately puts a stop to the operation of the valve. Should the float become water-logged the tank is sure to overflow. On the other hand, if it lodges in the ice the supply will be entirely cut off. In either case the tank is put out of commission until the water service men can be notified and the valve or float repaired. This means additional expense, to say nothing of the delay to traffic by a failure to get water at the proper time.

THE ANDERSON PATENT ALTITUDE VALVE.

A further detriment in this method of regulation is, that the valve being submerged, it is necesary to entirely drain the tank in order to repair it.

With the altitude valve all trouble resulting from water-logged or frozen floats or valves inside of tanks is entirely avoided. The valve is placed in the pit underneath the tank, or any other convenient place where it will be protected from frost, and accessible at all times, thereby maintaining a uniform height of water even in the coldest weather.

A further advantage is in being able to keep the tank full of water should it become necessary to make repairs. The height of water will not vary more than 10 to 12 inches when regulated by the valve, which can be located in the cellar or engine room, no matter how high the building is. It is a reliable valve to place in the pipe line connecting to water tanks.

The altitude valve has fully demonstrated that it is a very reliable and durable valve. It is manufactured by the Golden-Anderson Valve Specialty Co., 200 Pike street, Pittsburg, Pa.

"UNIT TYPE" OIL FILTER.

The most important and vital part of an oiling system is the oil filter and it naturally follows that if the filter fails to filter the oil perfectly, the system is a complete failure. Filtered oil must be free from all grit, dirt and foreign substances so as to avoid the clogging of the oil cup or feed pipe. Grit and dirt, if contained in the oil will increase the friction and wear on the machinery.

In the American oil filter "unit type" shown in Figs. 1 and 2, the dirty oil enters the waste oil receptacle and passes through the small perforations, flowing thence horizontally to the two filtering cylinders, and in passing to these cylinders the heavy impurities fall by gravity into the sediment pan and therefore, do not clog up the filtering cloths or filtering material. Each cylinder is wrapped with a cloth through which the oil must pass before entering the filtering cylinder.

After passing through a quantity of animal bone black, the oil passes down through the two tubes into the bottom of the tubes where the oil is spread out in a very thin film and is thoroughly washed by the water, and any remaining impurities in the oil are brought to the bottom of the filter and can be flushed out at any time desired by simply opening the gate valves which connect with the sewer.

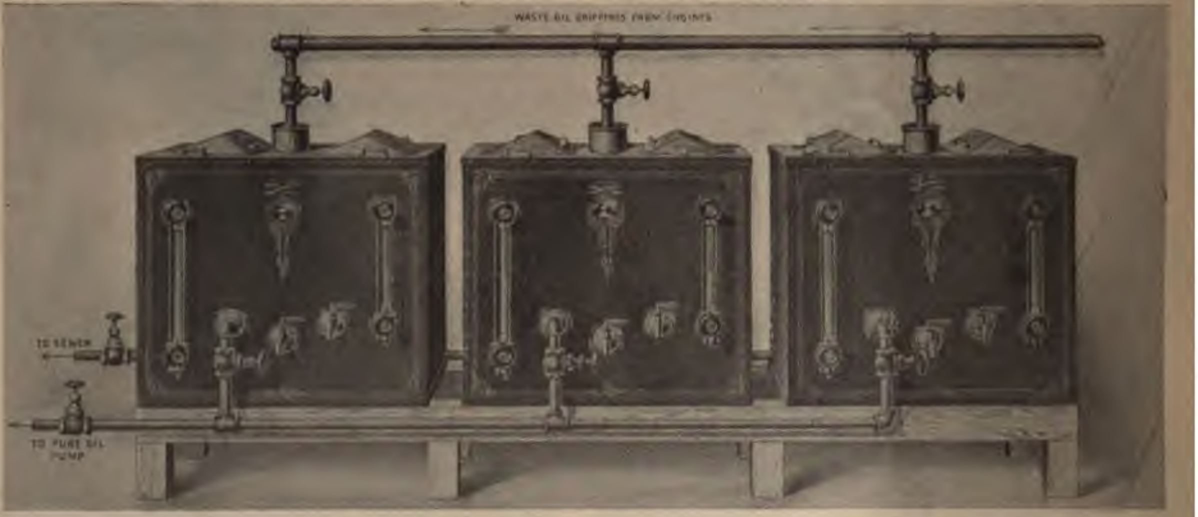


FIG. 1. THREE SECTIONS OF THE UNIT TYPE FILTER CONNECTED TOGETHER.

Special attention is called to the hot water chamber in the upper part of the sectional view, Fig. 2. The object in heating the oil before filtering is to cause it to flow more freely, thus increasing both the speed of filtration and filter capacity. It is said that ow to the effect of this hot water chamber that from to 75 per cent more oil can be filtered than by any ot method on the market occupying an equal amoun space, and that it will filter successfully the heav grades of oil.

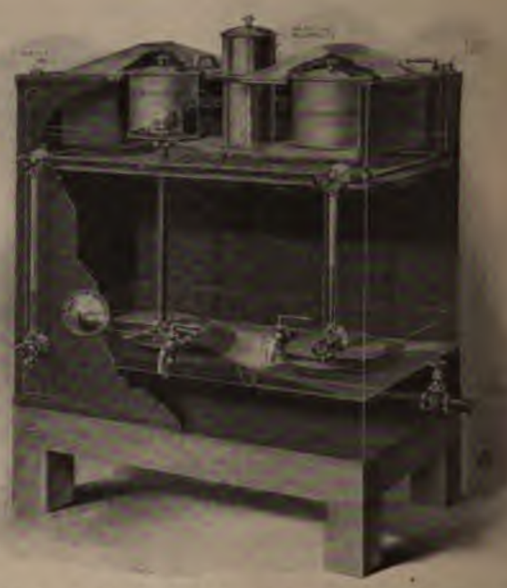


FIG. 2. THE AMERICAN "UNIT TYPE" OIL FILTER.

The unit filters are so constructed that they ca used with or without an oiling system, and can be stalled, if desired, without being connected to an oi system, and later on connected to the system if on added to the plant, without any extra expense. T filter may be cleaned without shutting down the wh system or disconnecting the pipe connections. If m than one unit is used, all that is necessary is to s off the flow of oil to the filters to be cleaned, allow the other filter or filters to handle the extra amour

Where only one filter is installed, the cleaning op tion is very simple. The cloth around one cylinder be removed instantly, and if the filtering material to be removed, unscrew one cylinder and screw · which is furnished for that purpose with each into the tube, so as to keep the dirty waste oil flowing into the cylinder. The other cylinder ontinue in operation while the one is being d.

American filter is suitable for use with gas or ıe engines of large capacity, as the hot water he engine cylinders can be used for the purpose ting the oil. The unit type also is adaptable with turbines, by reason of the exceptionally large ty of oil used on these machines.

1, shows three units connected and operating as ter, signifying at a glance that they are able to : a large amount of waste oil drippings from the s. The "Unit Type" of oil filter is manu- ed by the Burt Mfg. Co., 228 Main street, , Ohio.

DOUBLE SERVICE PACKING.

ı the engineer and employer will be interested »uble-Service packing," the product of the D. S. on Co., Philadelphia.

the name indicates, the quality of the packing med to be such that you secure "Double Ser- This means a wonderful saving in time and : to the engineer, when obliged to re-pack only ; often as necessary with other grades of pack- The employer not only economizes in the manner y shown, but also from the fact that while made naterial of the very highest quality, it establishes ıinely honest standard of prices which are said ower than the ones now prevailing.

ineers and practical employers are often dis- :d with the packing which they have been paying noney for right along, but do not change because re not sure what other kind to buy. To answer ıch questions, this firm offers you the personal :s of their packing expert, with more than 19 practical experience, for which they make ırge; not even suggesting that you buy their g. They simply tell you the best kind to get : work you have to do—the kind that will give :sults. There is many a dollar wasted for pack- ıich is not suited to the work for which is is used. ıny engineer sending name and address, the D. S. on Co. will mail free of charge a handsome . from life" colored picture entitled "Double e." Mention the Engineers' Review when g.

Oil in Boilers.

September issue of *Graphite*, the monthly pub- n of the Jos. Dixon Crucible Co., Jersey City., has been received. It is sent free to engineers rrite for it. The leading article for September :led "Oil in Boilers." For the first part it quotes marks of a contemporary on a paper entitled r Furnaces and the Effect of Oil on Their ıte Strength." This paper was read by Mr. Morrison before the North East Coast Institu- f Engineers and Shipbuilders of England. As bject is one that will interest our readers we mend those not already receiving *Graphite* to the Jos. Dixon Crucible Co. for a copy of the nber and subsequent numbers.

PERSONAL.

MR. J. D. SAFFORD, who for a number of years has served as president of the Chapman Valve Co., Indian Orchard, Mass., has resigned. He will be succeeded by Mr. E. A. Carter.

L. L. Willard, mechanical engineer for the Brown Corliss Engine Co., Corliss, Wis., has been appointed superintendent, succeeding Pelle Anderson, who resigned to become superintendent of the Power Mining & Machinery Co.

A COURSE in steam engineering is to be given this fall and winter by the Young Men's Christian Association of New Haven, Conn. W. H. Wakeman, author of Engineering Practice and Theory, has been chosen as the instructor.

MR. WALTER H. WHITESIDE has been elected president of the Allis-Chalmers Co., succeeding B. H. Warren, resigned. Mr. Whiteside became associated with the company in July, 1904, when he was made manager of sales. His election to the presidency is therefore a recognition and appreciation of his ability.

NEW BOOKS AND CATALOGS.

"The Industrial Problem," by Lyman Abbott, Geo. W. Jacobs & Co., Philadelphia, Pa. 5 x 7½, 196 pages, cloth, price $1. This volume is from the pen of the well-known Lyman Abbott. It deals with the industrial problem and shows that the organization of labor and capital marks a necessary step in the progress of the human race; that this step is scientific, economic, industrial, and ethical. The political solution and its regulation is taken up in the second chapter, giving the remedies for the evils of monopoly; political, industrial and ethical. The economic solution—reorganization, is taken up in the third chapter and the ethical solution in the fourth and last chapter. In these chapters the definition of capitalists and labor is explained and shows that the labor problem is really the question at issue as to the relation between capital, the capitalists and laborers. The ethical issue involved in the industrial problem is set forth in the last chapter. This is an interesting work and deals with the labor problem in a manner which holds the attention of the reader to the end.

THE LAW METALLIC PACKING CO., 44 Court street, Brooklyn, N. Y., have sent us a pamphlet describing their new improved Law metallic packing.

THE NORWALL AUTOMATIC air valve is described in a little booklet received from the manufacturers, Norwall Mfg. Co., 42 E. 23rd street, New York.

IDEAL METALLIC PACKING, which is manufactured by the Ideal Metallic Packing Co., of St. Paul, Minn., is fully described in a little folder recently received.

THE MONITOR DUPLEX AUTOMATIC pump and receiver which was recently patented by the Snider-Hughes Co., of Cleveland, is described in a folder recently issued by them.

THE D. T. WILLIAMS VALVE CO., 904 Broadway, Cincinnati, have mailed us a price list booklet of the Williams regrinding valves. This will be sent to interested parties upon request.

A LITTLE FOLDER has been recently received from the Fisher Governor Co., Marshalltown, Ia., which gives instructions in regard to ordering parts for the Fisher steam pump governor.

THE PUBLICITY MAGAZINE for September has been received and is as interesting as usual. It is published monthly by the Under-Feed Stoker Co. of America, Marquette building, Chicago.

A BOOKLET describing briefly, and illustrating the American boiler flue cleaner has been sent us by the American Boiler Flue Cleaner Co., 509 Broad street bank building, Trenton, N. J.

"THE RUST WATER TUBE BOILER" is the title of an attractive catalog issued by the Rust Boiler Co., German National bank building, Pittsburg. This catalog will be sent free upon request.

TATE, JONES & CO., PITTSBURG, are sending out circular No. 106 describing the Kirkwood natural gas burner. These burners can be applied to either the stationary or locomotive type of boiler.

CATALOG "B" 1905, has been received from the Rue Mfg. Co., of Philadelphia. This contains information in regard to their injectors, ejectors and other jet apparatus and will be sent upon request.

"TWO IN ONE LIGHTING MOTOR" is the title of Bulletin No. 72 received from the Wagner Electric Mfg. Co., St. Louis, which sets out to advantage their standard lighting and motor transformers.

THE LITTLE JAP HAMMER DRILL, manufactured by the Ingersoll-Sergeant Drill Co., 26 Cortlandt street, New York, is fully described and illustrated in Bulletin No. 2003 recently issued by this firm.

"THE BEST DUPLEX PUMP in the World" is the title of a booklet received from the Advance Pump & Compressor Co., Battle Creek, Mich. The advantages of this pump are fully described in the booklet.

THE DETROIT LUBRICATOR CO., Detroit, Mich., have recently issued an attractive catalog setting forth the advantages of their sight feed lubricators. This contains a complete price list of all their specialties.

CATALOG NO. 3, subject matter "Dump Cars," has been received from the Kilgore Peteler Co., 30 Avenue S. E., Minneapolis, Minn. This catalog shows numerous cuts of their dump cars and lists their specifications.

SHALLOWS IMPROVED AUTOMATIC water gage is described in a pamphlet issued by the Wm. S. Haines Co., 136-138 S. 4th street, Philadelphia. This contains a description of this gage, also a list of users of it.

WM. E. HILL & CO., of Kalamazoo, Mich., have recently sent us their 1905 catalog which illustrates and lists all standard machines as built by them at the present time. This catalog and other information will be sent upon request.

ADVANCE CIRCULARS HAVE BEEN received from the Crane Co., Chicago, describing their Craneweld flange joints, and Cranelap extra heavy flange pipe joints. The circulars give specifications and dimensions of these joints.

"COST OF FRICTION OR LOSS OF POWER" is the title of a pamphlet which can be obtained from Chas. H. Garlick, Pittsburg, Pa. It is a treatise on lubrication and touches upon the relative efficiency of grease and oil. It is free.

WE HAVE RECENTLY received a fine mailing card from the De La Vergne Machine Co., Foot E. 138th street, New York, which touches upon the subdivision of the properties of saturated steam. This card will be of interest to engineers.

WESTCOTT'S PATENT LATHE CHUCKS and little giant drills are fully illustrated and described in a catalog issued by the manufacturers, Westcott Chuck Co., Oneida, N. Y. Any one interested in these specialties should request catalog "A."

"WATER SOFTENED AND PURIFIED for all Purposes" is the title of a handsome, illustrated treatise on the softening and purification of water. This has been received from the Wm. B. Scaife & Sons Co., 221 First avenue, Pittsburg, Pa.

A HANDSOMELY PRINTED BOOKLET of 26 pages briefly describing DeLaval steam turbine machinery has been received. It is illustrated with a number of halftones. The DeLaval Steam Turbine Co., Trenton, N. Y., are the manufacturers.

THE DEARING WATER TUBE BOILER, manufactured by the Dearing Water Tube Boiler Co., Detroit, Mich., is described in a catalog recently received from this firm. It contains information in regard to this boiler and a list of sizes in which it is manufactured.

THE HOLMES SYSTEM is the title of a treatise on the purification of liquids by heat and centrifugal energy and the Holmes system of feedwater purification. The inventor of this system is Isaac V. Holmes, 1704 Buckingham place, Chicago.

DODD'S CROSS EXPANSION piston packing is described in a little pamphlet recently received from the Bowers Rubber Co., 42 Sacramento street, San Francisco, Cal. This pamphlet is accompanied by a testimonial letter which attests to the value of this packing.

A CIRCULAR describing Goetze's corrugated-jointing-rings has been received. The gaskets referred to are made of copper and asbestos and are said to give satisfaction. Further information will be sent inquirers by Friedrich Goetze, 723 East 141st street, New York.

A CATALOG HAS BEEN received from the Triumph Ice Machine Co., Cincinnati, O., describing their ice making and refrigerating machinery. The catalog is gotten up in very nice shape and will be of much value to any one interested in this class of machinery.

THE PLATT IRON WORKS CO., of Dayton, O., have sent us a handsome catalog illustrating and describing the Smith-Vaile air compressors. Fine illustrations display the different methods in which these air compressors may be used. This catalog will be sent upon request.

THE YOUNGSTOWN STEAM TRAP which is being placed upon the market by the Youngstown Steam Trap Co., 1100 Keystone bank building, Pittsburg, Pa., is fully described and illustrated in a catalog handed us. This trap contains many new features that will interest engineers.

"DUST COLLECTING" is the title of a catalog issued by the Hartford Blower Co., Hartford, Conn. Besides manufacturing exhaust systems, this firm make numerous other specialties such as steam, electric, and pulley fans for all purposes and forced and induced mechanical draft systems.

WALTER J. McKNIGHT, 70 Riley street, Buffalo, N. Y., has sent us a circular and blotter describing the receiver and oil separator which he invented. This device is for use in connection with heating systems. Mr. McKnight will be glad to give further information to all who inquire.

"MODERN STEAM, WATER and Air Specialties" is the title of a catalog sent us by Kieley & Mueller, 34 W. 13th street, New York. This illustrates the specialties which are manufactured by this concern. In the back of this catalog may be found much useful information for engineers.

THE CLEVELAND BRAND boiler compound, manufactured by the Cleveland Mfg. & Supply Co., Cleveland, O., is described in a pamphlet received from that firm. It contains numerous testimonials from prominent firms in regard to the good results obtained from the use of this compound.

THE FOOS GAS AND GASOLINE engines, manufactured by the Foos Gas Engine Co., of Springfield, O., are described in catalog No. 14, which has been issued by this firm. These engines can be equipped to operate with gasoline, naphtha, distillate, etc. Numerous cuts show their engines up to advantage.

THE CLEVELAND TUBE CLEANING CO., 80 Frankfort street, Cleveland, O., have sent us a folder showing the different kinds of cutter wheels, cone cutters, pins, tool steel drills, etc., for hydraulic turbine tube cleaners. They also make a cleaner which they recommend highly for use in water tube boilers.

THE BOOKLET for 1905 issued by Jas. Bonar & Co., Frick building, Pittsburg, Pa., which illustrates and briefly describes the Pittsburg feedwater heater and purifier, Pittsburg tubular feedwater heater, the Bonar gage cock, Bonar exhaust head and muffler, Bonar oil filters, steam traps, flue cleaners, etc., is at hand.

THE DE LA VERGNE MACHINE CO., foot of E. 138th street, New York, have sent us several handsomely printed folders describing the Koerting gas engine, the Hornsby Akroyd oil engine and the horizontal refrigerating machines and ammonia fittings respectively, which they manufacture.

A HANDSOME CATALOG has been received from A. Allan & Son, 486 Greenwich street, New York, who manufacture Allan's red anti-friction metal, metallic gasket metal, and metal flange disks. This catalog contains a fine cut of Andrew Allan, Sr., the inventor of Allan metal. This catalog will be of much interest to engineers and can be had upon request.

A FOLDER being distributed in the interests of Cling Surface has been received. It contains two testimonial letters, with photographs accompanying them, which strongly recommend Cling Surface. Any engineer having trouble with his belts should write the Cling-Surface Co., 154-160 Virginia street, Buffalo, N. Y., who will gladly give him any information desired.

IN THE 1905 CATALOG of Jas. McCrea & Co., 67 W. Washington street, Chicago, who manufacture a large and complete line of steam specialties, special attention is called to the Climax steam joint clamp and their modern flange clamp and emergency pipe clamp. Their other specialties are also fully described and illustrated. This catalog will be sent on request to any engineer.

"ECONOMIZING STEAM SPECIALTIES" is the title of the new catalog which has been issued in the interests of the specialties manufactured by the Williams Gauge Co., Pittsburg. This company manufacture safety feedwater regulators, auxiliary feedwater regulators, high pressure steam traps, steam governors, safety water columns, chain lever water gages tating regrinding gage cocks.

ORDER TO INTRODUCE their metallic packing to ers, the Pennsylvania Metallic Packing Co., 905 Dia- bank building, Pittsburg, Pa., will send a sample to any er who writes them, mentioning the Engineers' Review. the purpose for which it is to be used, also diameter of d diameter and depth of box. If the packing is satis- after 90 days' use it is to be paid for.

RNSBY-AKROYD OIL ENGINES are described in a me, illustrated catalog recently received from the Vergne Machine Co., of New York. This is printed best of coated book paper and the illustrations display nt types of these engines and plants in which they have stalled. This catalog is a fine example of the printer's l will be a valuable acquisition to any engineer's library. be had by mentioning the Engineers' Review.

VER TRANSMISSION APPLIANCES is the title of g No. 45 sent us by Patterson, Gottfried & Hunter, Ltd., entre street, New York. This company deals in of all kinds and sizes for all purposes, hangers, ball cket pillow blocks, roller bearings, vertical shafts, wall ts, couplings, friction clutches, counter shafts, belting, ission rope, etc. The catalog is a useful one to have l.

ERICAN STANDARD STEEL FITTING CO., 149- rk street, Milwaukee, manufacturers of a large line l drawn seamless steel work and ammonia and high e fittings, have recently mailed us their catalog "A" contains features known to be of the greatest signifi- to the trade. Any one interested or wishing estimates ices will receive immediate attention by writing the firm.

AMERICAN WOVEN LEATHER BELTING CO., ler building, Springfield, Mass., who manufacture the an woven leather belting, have sent us their catalog fully describes and illustrates the method of manufac- these belts. It also contains special instruction for g woven leather belting. Numerous testimonials in this testify to the fact that these belts are giving good tion.

HIGH SPEED, AUTOMATIC CUTOFF engines ctured by the Erie City Iron Works, of Erie, Pa., are very well known in the mechanical world, are lescribed in their latest catalog which contains many ustrations of the different parts of their engine. The is printed on first class book paper which displays strations to the best advantage. This catalog can be r the asking.

ALOG "D" has been received from the Wagener Steam Co., Canton, O. This firm manufacture Wagener du- eam pumps for different usages. This catalog illus- sectional views and complete views of their pumps. guarantee all pumps sold by them to do the work for they are designed, providing they are set up and op- as per instructions in their catalog. Any one interested tain the catalog by writing for it.

UINE ARMSTRONG STOCKS AND DIES, manu- d by the Armstrong Mfg. Co., Bridgeport, Conn., are ed in a catalog recently issued by the company. The t machines are plainly illustrated. The catalog con- lso a table of sizes and price list. This company also plain and hinged vises, wrenches, nipple holders for pipe cuttng machines, bushings, stands for pipe cutting reading machines, taps and reamers.

NEW CATALOG of the Golden-Anderson Valve ty Co., 200 Pike street, Pittsburg, Pa., shows that the y have changed their motto from "Worth Wins" to Has Won." It will be gratifying to their many to know that these specialties are being received so ly. The Golden tilting steam trap and the different f Anderson valves have undoubted merits. They are escribed in the catalog mentioned above. Every en- should write for one.

RD & LEE'S DIARY AND TIME SAVER FOR 1906, annual edition, is an especially comprehensive and e pocket diary and encyclopedia of timely and useful tion, embracing more numerous and important fea- an any of the previous issues. It contains in addition ary page for every day of the year, holidays, calendar 6, full-page "accounts" for each month, addresses and memoranda. It is handsomely bound in morocco, gilt edges, gold stamping, vest pocket size, price 25 cents. Laird & Lee, Chicago, publishers. Mention the Engineers' Review when writing.

ONE OF THE HANDSOMEST as well as most complete catalogs that has come to our attention is Catalog No. 70 recently issued by the Peerless Rubber Mfg. Co., 16 Warren street, New York. It contains 137 pages of interesting matter; nearly every page being illustrated by one or two illustrations in colors. The different articles are shown as nearly as possible just as they appear when they reach the engineer. Many different kinds of packing, for every service, as well as gaskets, hose, belting and other kinds of rubber goods are shown. In addition, the catalog contains much information of interest and value to engineers. It has a strong, durable cloth cover and will undoubtedly find a place in the libraries of hundreds of engineers. It is sent on request.

THE WHITE STAR CONTINUOUS oiling system is described in a very neat catalog recently received from the manufacturers, the Pittsburg Gage & Supply Co., Pittsburg, Pa. This catalog sets forth in an attractive manner their features of superiority over other oiling systems. The White Star systems are flexible and can be applied to any conceivable condition. They will show the same proportion of saving whether used in connection with engines of 100 or 10,000 horsepower capacity. This catalog also describes the special duplex oil pump, especially designed for use in connection with the White Star oiling systems, and also their oil storage reservoirs and other fixtures manufactured by this concern. This will be sent to any interested party upon request.

THE LATEST CATALOG of the C. & G. Cooper Co., Mt. Vernon, O., copy of which has been sent us, is a very handsome affair. The cover is especially so, being heavily embossed with one of their heavy duty Corliss engines in the center, with a background of gold. It contains many views of their different types of engines. The leaves are bound in such a manner that the pictures of the engines can be removed and framed, if desired. The Cooper Co. manufacture engines in sizes of from 50 to 8,000 horsepower. They report that the constantly increasing demand for their engines has forced them to double their facilities. Their machine shop and foundry are new and equipped with all the latest improvements. This enables them to turn out work of the highest grade in a short time. They will be pleased to furnish estimates on engines alone or upon complete steam plants.

THE IMPROVED CINCINNATI AIR COMPRESSOR is described in a 32-page bulletin, L 508, lately published by the Laidlaw-Dunn-Gordon Co., 114 Liberty street, New York city. This compressor is characterized by a new and simple air-valve mechanism by which the elasticity of poppet valves is combined with the quiet action, efficiency and high-speed qualities of positively moved valves, permitting the machine in all sizes, to be directly connected without gears or belt to electric motors and gas engines. In the present circular the adaptations of this compressor to different methods of driving and to different types of steam ends, as simple and compound, Corliss and Meyer gear, etc., are shown by numerous illustrations. The Cincinnati gear is applied to machines for all pressures, including those for 1,000 pounds per square inch and above for liquefying carbonic acid gas and charging compressed air locomotives.

TRADE NOTES.

A CABLE ORDER from Paris, France, for a large shipment of Cross oil filters has been received by the Burt Mfg. Co., Akron, O.

THE BOILER DEPARTMENT of the Aultman & Taylor Machinery Co., Mansfield, O., has been purchased by the Stirling Co., Barberton, O.

THE REEVES ENGINE CO., through their Chicago manager, Joseph B. Hall, have arranged with the Dwyer ing & Heating Co., of St. Paul, Minn., to handle the territory tributary to St. Paul. F. J. Spriggs, M. E., will be in charge of engineering matters for the Dwyer company.

THE CHAPMAN VALVE MANUFACTURING CO., Indian Orchard, Mass., through their treasurer, Mr. Dalton, report that the demand for their product has been so great that they cannot fill orders promptly. To overcome this difficulty they expect to erect several new buildings as quickly as possible.

THE FOSTER ENGINEERING CO., Newark, N. J., report that their factory is extremely busy and that they find it difficult to keep up with their orders. Recent orders of interest include one from the American Steel & Wire Co. for 16, 6-inch Foster non-return valves, and one from the Union Electric Light & Power Co., St. Louis, for 52 5 and 6-inch non-return valves of the same type.

THE CESSATION OF HOSTILITIES in the far East has already been emphasized by the fact that export orders are being received in America for large quantities of supplies and equipment. As usual, the Geo. W. Lord Co. are coming in for their share of this business, and have resumed shipment of Lord's boiler compounds to Japan and Russia. They have, since the signing of the treaty of peace, in addition to filling standing orders, received a cable order from their Validvostock agent for a carload of compound, to be shipped direct *via* Seattle, Wash. For the past ten years they have been making shipments regularly to all the far eastern countries.

THE LUBRON MANUFACTURING CO., Dept. S., 88 Broad street, Boston, Mass., manufacturers of Lubron grease, Lubron packings and Lubron pump valves, report business in an excellent condition. The pump valve particularly is having a large run. The Lubron Manufacturing Co. send free samples of Lubron grease to engineers who have never used it and who are having lubricating troubles. It has solved this perplexing problem for many engineers. When writing, tell where it is to be used and give any other information that you think will assist the manufacturers in meeting your requirements. Their new catalog will soon be ready. They wish to send you a copy.

A GOOD IDEA of what Albany grease will accomplish may be obtained from the experience of W. Cook, chief engineer of Hotel Robinson, San Diego, Cal., who writes Messrs. Adam Cook's Sons, 313 West street, New York, the only makers, as follows: "I have given your grease a hard test, with the result that it will be the only lubricant used in our plant. The result of a trial on the crank of our 14 x 20 Atlas engine (which required three pints of engine oil for a 5-hour run, and then ran hot) was that a No. 2 perfect compression cup,, holding ¼-pound of grease, was sufficient to lubricate the crankpin referred to for 20 days, or 50 hours' running, and on all other bearings the grease was equally satisfactory. No. 'X' gives better satisfaction than Nos. 2 and 3, which you sent, owing to the tropical climate."

THE BUSINESS of the Liberty Mfg. Co., Pittsburg, has long since outgrown their old quarters and the company are now moving into their new fireproof shops, just completed and which are now being equipped with new tools of the most modern design. The company have recently acquired the exclusive rights to manufacture the Twin strainer from Mr. G. U. Merrill, Paterson, N. J., and are now ready to fill orders promptly. The success of the Twin strainer has been phenomenal, considering the short time it has been on the market, and the favorable reports received from the rapidly increasing number of users are very flattering indeed. One electric light company report that their three Twin strainers have proven most satisfactory and are among the most important and most indispensible features of their plant. Mr. Merrill will continue to sell strainers, acting as a special agent for the Liberty Mfg. Co. in this department.

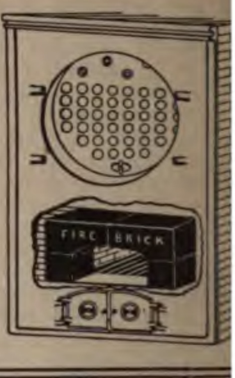
THE FOLLOWING LETTER will be of interest, con as it does from one of the largest plants of its kind in country: "Cling-Surface Co., Buffalo, N. Y.—I received of the first packages of Cling-Surface ever sold (Dec. 1897) and employed it at once for the belts in this plant. that time we had about 12 belts, ranging from 10 to 24 in in width, on a daily average load of 7,000 horsepower. T were not new belts and were all as tight as we could get th with constant attending trouble and hot boxes. In fact, daily consumption of ice for bearings was 50 pounds. Cl Surface very soon stopped the slipping and allowed all t belts to be run slack, with the ease on bearings and eng which this signifies. In a month we stopped using ice and no hot boxes. These belts ran slack year after year wit a particle of trouble, carrying fullest loads, and have car as high as 10,000 total horsepower. We use Cling-Sur now, but are direct connected in the power house. T same belts, however, will be installed in a new plant being built, which attests to their present excellence. T are clean, pliable, waterproof and in perfect condition. opinion of Cling-Surface, after seven years of experienc entirely favorable, with no exceptions. Jos. Gregory, C Engineer, International Railway Co."

MISCELLANEOUS.

ENGINEERS, ELECTRICIANS, FIREMEN, MACH ists, etc.—Send for new 52-page pamphlet containing quest asked by Examining Board of Enginers. SENT FREE. A. Zeller Book Co., 26 S. 4th street, St. Louis.

SALESMAN WANTED.—We want salesmen trav among engineers to sell France metallic and fibrous pack Good inducements in unoccupied territory. Address Fr Packing Co., State street, Tacony, Philadelphia, Pa.

THE "NEW YORK SPECIAL" of the Pennsylvania L leaves Cleveland 5:00 p. m., arives New York 8:15 a. m Pennsylvania standard dining car. Through sleepers. R vations at New City Ticket Office, 112 Euclid avenue, Col Arcade. J. B. Modisette, Dist. Pass. Agent, Cleveland, O.



FIRE BRICK

Boiler Door
Arch and
Jambs

Write for Catalogue and Prices.

PRESBREY FIRE BRICK WORKS
208 Somerset Ave.
TAUNTON, MASS.

THE GOLDEN TILTING STEAM TRAP

WORTH WINS

The Anderson
Cushioned
Non - Return Valves

THE GOLDEN TILTING STEAM TRAP is positive at all times. A glance at the trap tells how it works. **No floats, no valves, no buckets inside of trap. All working parts on outside.**

act as a safeguard in emergencies in all plants where high pressure steam is used.

They will automatically cut off the steam in case of accident to the boiler; also act as a safety stop to prevent steam from being turned into a cold boiler.

Absolutely no possibility of chattering or hammering; there are a great many features about these valves with which you should be familiar.

We have other interesting specialties.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
200 PIKE ST. PITTSBURG, PA.

Is your plant as economical as it might be?

The kind of packing used makes a mighty big difference in the economy of a steam plant. **You know that!** If you have never tried

Lubron Packings

you have a pleasant surprise in store for you. They are specially treated with

(TRADE)

LUBRON

(MARK)

which is well-known as one of the best lubricants on the market. Thousands of engineers can testify to that.

LUBRON PACKINGS outwear and outlast all others and are self-lubricating.

Send for trial order and you will use them always.
We will send a fre sample of LUBRON if you ask for it.

The Lubron Mfg. Co.

DEPT. 8.

88 Broad St. BOSTON, MASS.

Good Friends.
The engineer who has Cling-Surface for his belts has no belt troubles.
Every belt he owns runs easy or slack, pulls like a chain, never slips, never gives him trouble or worry.
Cling-Surface is not sticky, but is a belt filler, penetrating INTO the belt and leaving it clean, pliable, preserved.
We sell Cling-Surface on 60 days trial, guaranteed.
Write us.

Cling-Surface Co.,
154-160 Virginia St.
Buffalo, N. Y.

DON'T WAIT till the boiler tubes and shell are in a dangerous condition, as they will be if the scale is allowed to accumulate on them. Get a trial order of

International Boiler Compound

and see what it will do for you. We know, but we want you to find out for yourself. A special proposition for engineers.

INTERNATIONAL BOILER COMPOUND CO.,
47 MARKET ST. CHICAGO, ILL.

NUGENT'S

Catalog of new and up-to-date Oiling Devices and Valuable Treatise on
"How to Oil an Engine"
will be sent free of charge to any engineer.

It contains a lot of good pointers.

WRITE TO
Wm. W. Nugent & Co., S.E. Cor. Canal & Randolph Sts., Chicago, Ill.

Model Automatic (Stoker) Furnace

Patented in 1903.

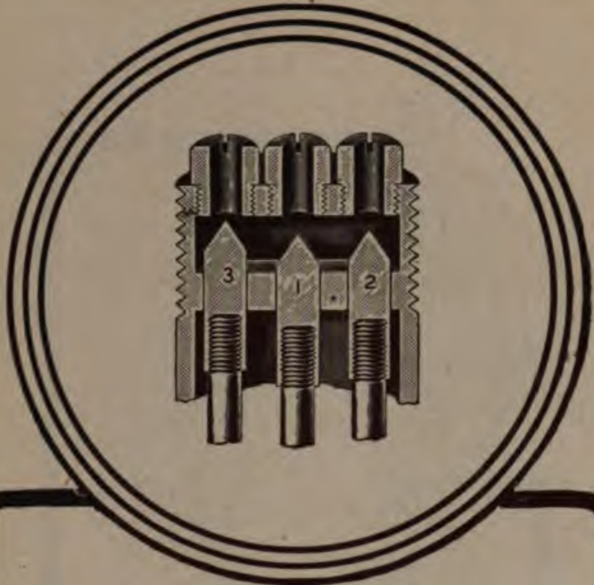
Gives 10 to 15 per cent better economy
15 to 25 per cent greater capacity
than any other type.

Cleans automatically and wastes less fuel in the ash, than any other, whether mechanical or hand fired.

Write for Illustrated Circular B.

Model Stoker Company

DAYTON, OHIO



The "Valve-Rightness" of a Wright Steam Trap

Admittedly, the most important part of a steam trap is the valve arrangement.

If that goes wrong the entire trap goes wrong.

In the construction of our "Emergency" Trap we make sure of the valves above everything else before a trap leaves our factory.

They must test perfectly. The first valve must take care of large amounts of water, under different pressures. After that we put the trap to an emergency test, subjecting it to excessive amounts of water. The second valve, and then the third, are brought into operation, and only when a trap undergoes this test without wasting a particle of steam, do we pronounce it ready for sale on our guarantee.

There is a good deal to interest engineers in our catalogue. Your name on a postal will get you a copy.

Wright Manufacturing Co.,

82 Woodbridge St., Detroit, Mich., U. S. A.

How Can Water or Oil Possibly Get Through this Separat with the Steam?

AUSTIN FIGURE "B" HORIZONTAL PATTERN.

The steam may pass through it in either directi
the result will be the same.

Absolutely perfect separation of water from steam, or of oil and impurities from exhaust.

Looking at the design of this Separator will
you that it will do good work.

But there is a reason under the surface fo
efficient operation—

The baffle plates are set at an angle that c
the steam to rebound at an opposite angle. This
up a centifrugal action that impinges all water or i
ities against the corrugated sides, whence they
drained down into the receiving chamber and then
through the drain pipe.

Perfect separation is a matter of certainty-
guesswork—and we let you prove it before bu
Ask for Catalogue 15, just issued, detailing all style
Austin Separators.

Austin Separator Co

90 Woodbridge Street,

Detroit, Mich., U. S. A.

Trimo" Bull Dog

Trade-Mark

Awarded the Gold Medal, St. Louis Exposition, 1904.

Strongest chain wrench made. Flat link or cable. The chain is not attached to the jaws, but to the handle, therefore withstands much greater stress. To reverse wrench, simply loosen the chain. Every one thoroughly tested. All parts interchangeable and fully guaranteed. Drop-forged throughout.

Catalog No. 22 mailed free. Send for it.

RIMONT MANUFACTURING COMPANY,

39 ARMORY AVENUE, Dept. C **ROXBURY, MASS.**

The Standard Steam Trap of America

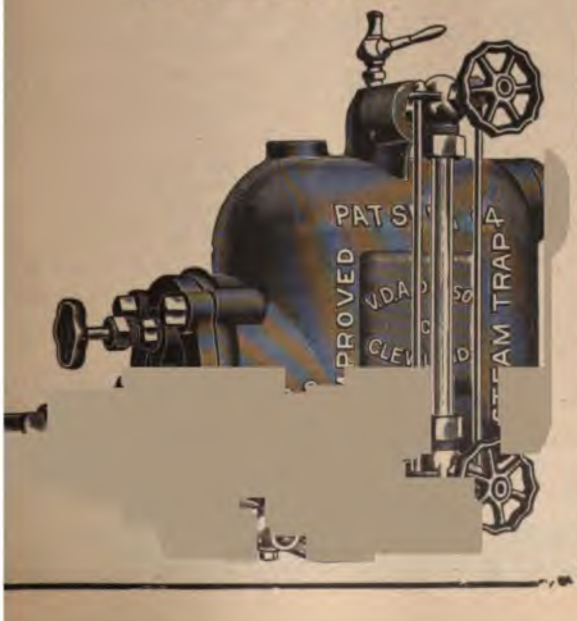
IS THE

NDERSON

MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.



The Reliance Steam Trap

PERFORMS ITS DUTY ALL THE TIME.

When it comes to you it is fit and ready.

Connect it up, set it at work and forget it. It needs no attention, no tinkering, no fussing with There's nothing about it to get "out of whack" and it will last practically forever.

You might be interested in the catalogue.

The Reliance Gauge Column Co.

86 E. Prospect Street,

CLEVELAND, OHIO.

Steam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.

Albany, N. Y., U. S. A.

Established 1871.

Fred'k Townsend, Pres.

Jas. H. Blessing, Gen. Mgr.

An Acme Oil Filter

will not only put a stop to serious oil waste but accomplish a yearly saving of four times its first cost.

We will send you

An Acme Oil Filter

of a size suited to your requirements on trial for 30 days. If it does not filter more oil, better and in less time than any other oil filter of similar capacity, send it back at our expense.

Walter L. Flower & Co.
1011 CHEMICAL BLDG.
ST. LOUIS, MO.

One for me
One for the Oil Company

Thousands of lubricating oil users have, with the help of th

WHITE STAR OIL FILTER

cut their oil bills squarely in two.

This economic power plant fact is one of vital importance every careful manager—easily demonstrated—quickly prov

We will be pleased to send a sample Filter on 30 days' trial FREE. If it does the work you keep it, if not, send it back.

Booklet "J" tells you all about this perfect and practical device.

PITTSBURGH GAGE & SUPPLY CO.
PITTSBURGH, PA.

OIL FILTRATION EXPERTS.

ALPHABETICAL LIST OF ADVERTISER

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Quaker City Rubber Co.........
Quincy Engine Works...........

Reeves Engine Co...............
Reliance Gauge Column Co......
Robertson & Sons, Jas L.........
Ruggles & Ruggles...............
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Snider-Hughes Co...............
Standard Oil Co.................
Starrett Co., L. S................
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Stewart Heater Co...............
Toledo Pipe Threading Machin Co. ....
Trimont Mfg. Co................
Vacuum Oil Co..................
Wheeler Condenser & Engineer ing Co. ....
Williams Valve Co., D. T.......
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American Oil Filter

"Unit Type"

THIS STYLE OF FILTER will commend itself to power plants where the space given to oil filters is limited, yet a large filtering capacity is required. Each "Unit' 'is 42 inches long, 3 feet high and 28 inches wide ,and has a filtering capacity of 160 gallons in 24 hours. The filter can be operated with or without an oiling system, and is so constructed that any number of "Units" can be operated as one filter or separately as desired. In cleaning the filter the oil service is not interrupted, and it is not necessary to change any pipe connections. This feature is a very important one when considering the question of filters suitable for oiling systems. The American Filter is so constructed that any kind of filtering material can be used successfully. They are **guaranteed** to clean the heaviest grades of oil perfectly, such as cylinder, lard, crank case, gas engine, etc. If you have tried to clean heavy oils in other makes of filters without success, order one of our "Unit" Filters on 30 days' trial, subject to your approval in every respect. If not satisfactory, return same and we will pay the freight charges **both** ways. Is that fair enough?

If you contemplate installing an oil filter, for use with or without an oiling system, ask your engine builder, supply house or oil company to send you one of our American Filters, "Unit Type," on trial subject to approval, or write us direct.

We have just issued a new 48-page catalogue, which describes and illustrates our various Oil Filters and Exhaust Heads, and should be in the hands of every engineer. Advise us the size of your engine and whether or not your plant is equipped with oil filters or exhaust heads, and we will be glad to send you a copy free of charge.

The BURT MFG. CO.,

Largest Manufacturerrs of Oil Filters in the world.

228 Main Street **AKRON, OHIO, U. S. A.**

Also supplied by Oil Companies, Dealers and Power Contractors.

VACUUM OILS

Are known and used in every corner of the world where machinery runs. They are the standards of value throughout the whole world; they lubricate every kind of machinery; not the same oil for all machines, but the right oil for each class.

They are made to fit every condition and are used everywhere because they are the best.

Once used VACUUM OILS are always used.

These oils are made at Rochester and Olean, N. Y., and are distributed throughout the world from local branches.

Abroad they are distributed from ***one hundred and twelve foreign warehouses*** and at home they are sold in every city.

VACUUM OILS

reduce friction to the limit, thus saving power. They are always uniform; can always be depended upon. They do their work better than other oils and cost less when the amount of work done is considered.

VACUUM OIL COMPANY

ROCHESTER, N. Y.

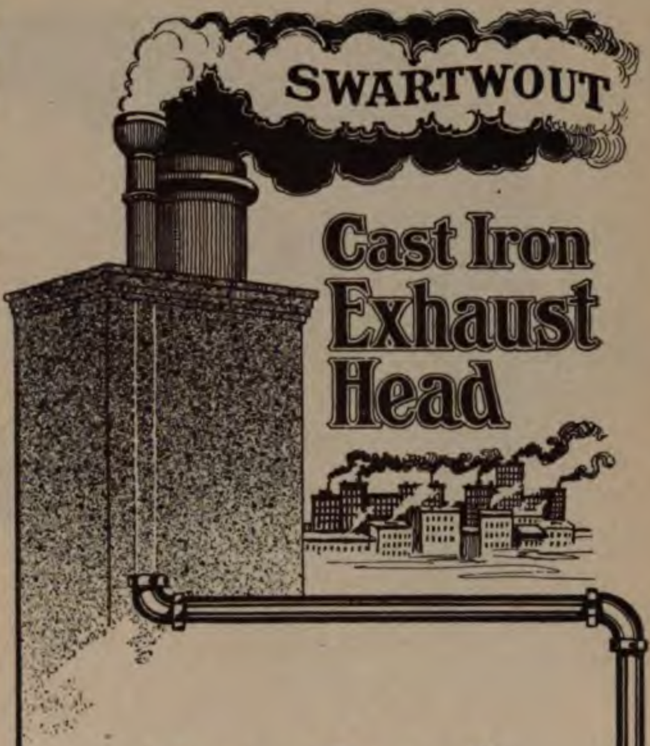
R SPECIFIC PURPOSES.

hen we say HARRIS VALVE OIL is the
nternal working parts of an engine, and HAR-
IGINE OIL for outside working parts, we
at the lubricant used for the outside parts of
e, cannot in any way be adapted for internal
other words, you can't split the difference
ke an oil that would come any where near
onomical and suitable for both purposes.
e reason is perfectly plain. Oil used in the
with saturated steam, must come in contact
re or less moisture, therefore, it must be suffi-
dhesive to cling to the metallic surfaces, yet
roperties which will allow it to mix with the
ithout impairing its lubricating value.
der the conditions of superheated steam, this
is practically eliminated and a different oil is
r one that will withstand the additional units of
proportion to the degree of superheat), and
t have sufficient body to cover the metallic
sufficient to prevent friction and wear. For
use these conditions are not imposed.
u would know the economy of HARRIS
you would tell us of the conditions surrounding
nt, and will take advantage of the liberal
on that we are ready to make to you.

W. Harris Oil Co.

South Water Street,
PROVIDENCE, R. I.

& BOWEN, 36 Fremont Street, San Francisco,
Pacific Coast Agents.



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As a manufacturer you have implicit confidence in your product—so have we.

Our confidence takes the shape of allowing our Swartwout Exhaust Head to prove itself in actual operation.

We will ship you a Swartwout Cast Iron Exhaust Head on 30 days' trial, or longer, if necessary, to satisfy you of its superiority.

If it isn't better — more practical and more economical than any Exhaust Head on the market — send it back at our expense — we take all the risk — write for description anyway.

We've some interesting facts to present.

Send for booklet on the Swartwout Steam Separator FREE.

The Ohio Blower Co.
SOLE MANUFACTURERS
CLEVELAND.

This Knife Free

CUT OUT a sample of scale from your boiler, then
CUT OUT the coupon and mail it to us with the scale.

Then we will send--you free of charge--a high grade pocket knife--two blades--size of illustration; also some information regarding

Lord's Boiler Compounds

and how they remove scale. The superiority of our products is proved by the growth of our business. We now operate the largest plant in the world devoted to the analysis of scale and the preparation of water purifying chemicals.

Cut out the extra work caused by scale.

Cut out burning too much coal.

Cut out experimenting with ready-made boiler compounds.

Cut out and mail this coupon today.

To
Geo. W.
Lord Co.
2238-50
N. 9th Street,
Philadelphia, Pa.

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, and send me, free of charge, a certificate of analysis and the knife.

Number of boilers in use ________

Capacity of each boiler ________

Frequency of cleaning boilers ________

Frequency of opening the blow-off during working hours ________ *River or other source of water supply* ________

Boilers are used about ________ *hours out of 24*

Boiler compound now used ________

Name ________

Street and Number ________

City ________ *State* ________

Firm's Name ________

Eng. Review *Date* ________ 1905.

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AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Can be used in every style of grease cup made, which cannot be done with *any other* lubricant.

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Cost of using ALBANY GREASE

We solicit your inquiries. We guarantee satisfaction. Good goods are cheapest in the long run. Write us or call and see us the next time you are in New York.

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Our Special Offer. A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

ADAM COOK'S SONS,

313 West Street, NEW YORK CITY, U. S. A.

A VALUABLE CATALOGUE "Graphite Lubricants" FREE ON REQUEST

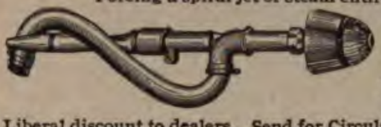
EVERY ENGINEER SHOULD HAVE IT FOR REFERENCE

Ask for Catalogue No. 164-I

Joseph Dixon Crucible Co. Jersey City, N. J.

Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.



Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO,

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ESTABLISHED 1855

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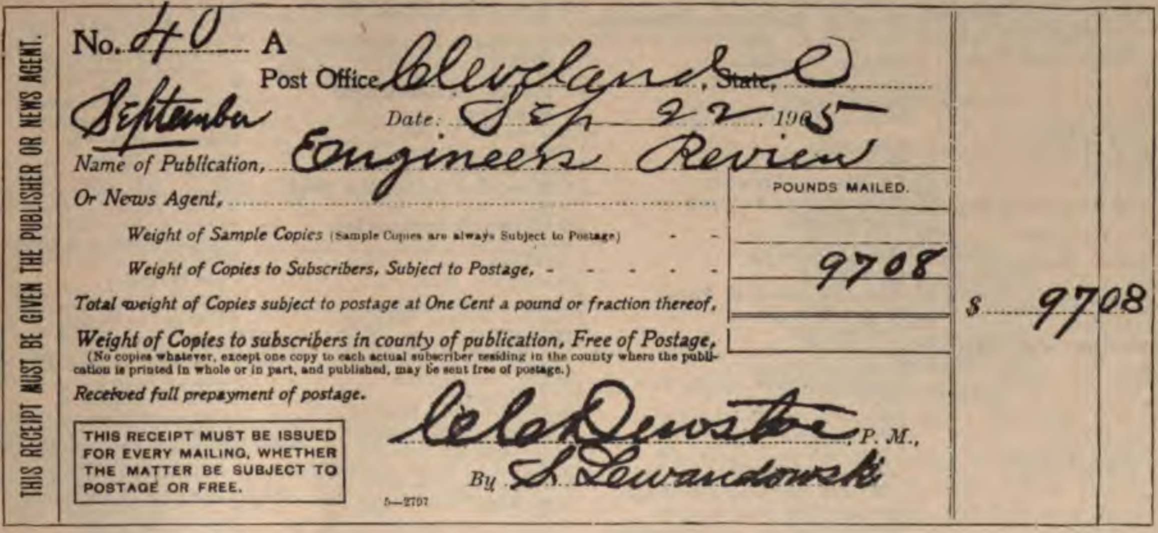
If so, we are glad to show you this. The Engineers' Review NOT ONLY CLAIMS but proves a circulation of 20,000 copies per issue. Below is a fac-simile of the Post Office receipt. See explanation under cut.



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By S. Lewandowski

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BEST TUBE CLEANER ON THE MARKET.

The DEAN Boiler Tube Cleaner

Removes Scale from Both Sides of the Tube.

FOR WATER TUBE BOILERS

Never Injures Tubes
Over 6,000 in use.

Used by Largest Power Plants in the World.

FOR RETURN TUBULAR BOILERS

Used in all Industries.
Cleaner Loaned for Trial.

The Dean proves the fallacy of antiquated compounds, for it will remove bushels of scale from tubes in boilers where compounds are used. **We guarantee the Dean will pay for itself in fuel saved—no matter what device or method you are now using to free your tubes of scale.** Prove it to your satisfaction that the Dean is best by accepting our offer to loan you a Cleaner without obligation to purchase.

What one of the 6,000 users of the Dean says.

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Gentlemen:—We have passed your bill for the Dean Boiler Tube Cleaner and accepted it. We have had for the past year a great deal of experience in new devices, all making great claims to our advantage. We have become prejudiced against experimenting and your device has come under that prejudice.

Our men have reported that our boilers were perfectly clean, as we have been using filtered water and washed our boilers very carefully every two weeks and used all preparations for preventing scales. Upon your urgent request for a trial, we thought best to make an attempt, which we have done. Our engineers and ourselves think it is a desirable machine to keep, it has settled the long dispute between them and ourselves as to whether our boilers were clear of scales. Thanking you for your courtesy in allowing us to make the trial, we are, yours truly,

THE TAYLOR-ATKINS PAPER CO.
per C. F. T.

Send Size of Tubes Today and Rid Your Boilers of Scale at Once.

"Boiler Room Economy," a pamphlet we issue, tells all about scale, and about this trial offer. Send for it TODAY.

Wm. B. Pierce Co., 325 Washington St. Buffalo, N. Y.

Classified Index for Buyers.

For addresses of manufacturers refer to the Alphabetical Index on page 48 which gives the pages on which the advertisements appear.

Air Compressors
Quincy Engine Wks
Snider-Hughes Co.

Air Compressors, Gasoline
Columbus Machine Co.

Alarms, High and Low Water
Crane Co.
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Arches and Jambs, Boiler Door
Presbrey Fire Brick Works

Arch Plates, Boiler
Lamprey Co.

Automobile Fittings
Lunkenheimer Co.

Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.

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Quaker City Rubber Co.

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Snider-Hughes Co.

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International Boiler Compound Co.

Boiler Door, Arches and Jambs
Presbrey Fire Brick Works

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Holyoke Steam Boiler Works.

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Liberty Mfg. Co-
Maurer, Labadie & Co.
Pierce Co., Wm. B.

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McCrea & Co., Jas.

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McCrea & Co., Jas.

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Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Cocks, Gas
Pittsburg Gage & Supply Co.

Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.

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Dixon Crucible Co., Jos.

Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.

Compounds, Car Axle
Lubron Mfg. Co.

Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.

Compounds, Lubricating
Keystone Lubricating Co.

Condensers
Snider-Hughes Co.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Cooling Towers
Wheeler Condenser & Eng. Co.

Counter shafts
Myers & Bro., F. E.

Crank-pin Center Oilers
Nugent & Co-, W. W.

Crosshead-Pin Telescope Oilers
Nugent & Co-, W. W.

Cutters, Gasket and Washer
McCrea & Co., Jas.

Cutters, Tube
Lagonda Mfg. Co.

Cylinders, Artesian Well
Myers & Bro., F. E.

Cylinders, Irrigation
Myers & Bro., F. E.

Dividers
Starrett Co., L. S.

Disks, Rubber
Peerless Rubber Mfg. Co.

Dry Kilns
Ohio Blower Co.

Dust Collectors
Ohio Blower Co.

Dynamo and Motor Brushes, Graphite
Dixon Crucible Co., Jos.

Eccentric Telescope Oilers
Nugent & Co-, W. W.

Ejectors
American Injector Co.
Ohio Injector Co-
Penberthy Injector Co.

Engines, Blowing
Buckeye Engine Co.

Engines, Gas and Gasoline
Buckeye Engine Co.
Columbus Machine Co.

Engines, Gasoline Hoisting
Columbus Machine Co.

Engines, Hoisting
Quincy Engine Wks.

Engines, Steam
American Engine Co.
Bates Machine Co.
Buckeye Engine Co.
Cooper Co., C. & G.
Harris Steam Engine Co-, Wm. A.
Ohio Blower Co.
Quincy Engine Works.
Reeves Engine Co.
Russell Engine Co.

Exhaust Heads
Burt Mfg. Co.
Flower Filter Co., Walter L.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.

Fertilizer Dryers
Anderson Co., V. D.

Filters, Oil
Burt Mfg. Co.
Flower Filter Co., Walter L.
Lippincott Steam Spec. & Sup. Co.
Maurer, Labadie & Co.
Nugent & Co-, W. W.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.

Fire Brick
Presbrey Fire Brick Works

Filterers, Scale
Wright Mfg. Co.

Fittings, Brass Hydraulic
Pittsburg Gage & Supply Co.

Fittings, Steam
Lunkenheimer Co.
Sterling Lubricator Co.

Floats, High Pressure
Reliance Gauge Column Co.

Flue Cleaner Rods
McCrea & Co., Jas.

Flue Cleaners
Bushnell & Co., John S.
Cleveland Flue Cleaner Mfg. Co.
Robertson & Sons, Jas. L.
Ruggles & Ruggles.

Furnace Feeders
Ohio Blower Co.

Furnace, Patent
Holyoke Steam Boiler Works.

(Continued on page 56.)

TRY IT

'hat is our argument. If it don't "make good," send it back.

RUGGLES *PERFECTION FLUE CLEANER*

; not only the simplest machine of the kind on the market—***it is the best.***

the only self adjusting cleaner made. This cleaner is result of years of experience and hard work. All you : to do is to insert the handle and go to work. Perfec- does the rest. You can see what it is—we know what ill do. We will send one on trial for thirty days to onsible parties. Isn't that fair? Write today.

Ruggles & Ruggles
BATAVIA, ILLINOIS.

First Cost

is not the most important item in tube-cleaners. although

The Weinland

is all right as to that, but for economy in operating and small cost for extra parts it is unequalled.

Thousands in successful use the "Round World Over," but we boast not of that. Our aim is **STRENGTH, EFFECTIVENESS, DURABILITY.** Saving to you, **TUBES** and **COAL**, that's what you're after.

Get our Catalog explaining our Tube Cutter, Damper Regulator and Reseating Machine, all sent on approval; and order a cleaner on trial. You'll keep it.

The Lagonda Mfg. Co.,
Boiler Cleaning Experts—At it 20 Years.
SPRINGFIELD, O., U. S. A.

ightning Tube Cleaner" Features

1—Cleans scaled tubes inside or outside.
2—Propelled by water, air or steam.
3—Does the work quick.
4—Saves $2.00 every 10 hours run metered water bill.
5—Motor Wheel utilizes a compound power.
6—Construction overcomes cone and ball breakage.
7—Has re-sharpening, non-breakable cleaner head.
8—Future repairs, very small item.
9—Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

on approval. Attractive proposition to State Agents.

MAURER, LABADIE & CO.
St. Joe Street, South Bend, Ind.

'ITH ONE HAND

you can thread a 2-inch pipe — that is, if you use a

No. 1 Toledo
Adjustable Die Stock

It threads pipe from 1 to 2 in. inclusive

WE ALSO MANUFACTURE LARGER MACHINES.

Write for Complete Description. Address Dept. E. R.

e Toledo Pipe Threading Machine Co.
TOLEDO, OHIO

Armstrong's Pipe Threading and Cutting Off Machines

For Hand or Power.

No. 0 Machine.

Save time and labor. Strong and simple in construction. All driving gears are enclosed in oil chambers, keeping them lubricated and free from dirt.

Genuine Armstrong Stocks and Dies.

The Armstrong Mfg. Co.,
Bridgeport, Conn.

New York Office—139 Centre St. **Catalogue sent on request.**

Thorough Boiler Tube Cleaning

with the most comprehensively designed tools

THE TORPEDO **THE DEMON**

THE "TORPEDO"
REMOVES ALL SCALE FROM TUBES OF FIRE TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/8 INCH IN THICKNESS OF SCALE
PROLONGS LIFE OF TUBES
SAVES COMPOUND
CENTERS ITSELF IN TUBE
STRIKES SAME IN EVERY DIRECTION
STROKE IS LIMITED AND CUSHIONED
DOES NOT HAMMER BUT VIBRATES THE TUBE
IS ABSOLUTELY SAFE AND EASILY OPERATED
HAS BUT ONE MOVING PART
WILL LAST A LIFETIME
DOUBLE ACTING VIBRATOR
AUTOMATIC CENTERING LUG
AUTOMATIC CENTERING LUG
SCALE
TUBE

OPERATED BY WATER
THE "DEMON"
REMOVES ALL SCALE FROM TUBES OF WATER TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/16 INCH OF SCALE
IS 42 TIMES AS POWERFUL AS TURBINE CLEANERS
DOES NOT HAMMER OR GRIND BUT CUTS LIKE LATHE TOOL
CENTERS ITSELF AND CUTS SAME TOP, BOTTOM & SIDES
ADJUSTABLE CUTTER STOPS PREVENT INJURY TO TUBES
ROTARY PISTONS ARE ACTED UPON BY DIRECT PRESSURE AS IN STEAM ENGINE
HAS ROLLER BEARINGS

The marvelous success of the "Torpedo" is largely due to the fact that the principle upon which this machine removes the scale is the only right one and which is found in this machine only.

There is a right and a wrong way to do everything and this is especially true of boiler cleaning.

Vibration as opposed to the dangerous and out-of-date method of hammering the tubes is the system used in the "Torpedo."

Both methods will remove scale but the vibration principle of short strokes, light raps of great rapidity (11,000 per minute) is the only way that boiler tubes can be safely and successfully cleaned by a machine that strikes the tube.

This is the machine that you have long been looking for. It is not a "turbine" or a "hammer" machine. All bad features of those machines for water tube cleaning are absent and their advantages retained. In other words the "Demon" has the safety and ease of handling of the "turbine," but with 42 times the torque or twisting power.

If you don't believe it just try to hold the cutter arms of the "Demon" from revolving when the water pressure is applied and you will think you might as well try to stop a locomotive.

It doesn't matter how thick or how hard the scale is the "Demon" will walk through it. The cutters are limited in their outward movement so when the tube is clean these cutters swing "free."

☞ **Read!** **A fair and square proposition** **Read!** ☜

Write to us the kind of boilers and size of tubes and we will forward to you on **Free Trial** either of the above cleaners. Both are great money savers. Try one. None better exists anywhere.

THE GENERAL SPECIALTY CO., 73 Carroll Street,
Buffalo, New York

(Continued from page 54)

Fusible Plugs
Lunkenheimer Co.

Gage Glass Reflectors
Lubron Mfg. Co.

Gage Glass Rings
Pennsylvania Rubber Co.

Gages, Oil
Lunkenheimer Co.

Gages, Steam
Ohio Injector Co.
Pittsburg Gage & Supply Co.

Gages, Recording
Pittsburg Gage & Supply Co.

Gages, Water
Lunkenheimer Co.
Penberthy Injector Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Gaskets
Goodyear Tire & Rubber Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Gear Cutting
Chicago Rawhide Mfg. Co.

Gears, Rawhide
Chicago Rawhide Mfg. Co.

Generators
American Engine Co.

Governors, Pump
Albany Steam Trap Co.
Fisher Governor Co.
Foster Engineering Co.

Graphite
Dixon Crucible Co., Jos.

Graphite, Flake
Dixon Crucible Co., Jos.

Grate Bars
Bushnell & Co., John S.
Holyoke Steam Boiler Works.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grates, Shaking
Lippincott Steam Spec. & Sup. Co.
Martin Grate Co.
Robertson & Sons, Jas. L.

Grease
Cook's Sons, Adam.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
Lubron Mfg. Co.

Grinders, Valve
Quaker City Rubber Co.

Hammering Machines, Die Plate
Bates Machine Co.

Heaters and Purifiers, Feedwater
Bates Machine Co.
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
National Pipe Bending Co.
Quincy Engine Wks.
Robertson & Sons, Jas. L.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Heaters, Hot Water House
National Pipe Bending Co.
Stewart Heater Co.

Heating Apparatus
Ohio Blower Co.

Hose
Goodyear Tire & Rubber Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Indicator Instruction
Indicator Instruction Co.

Indicators, Speed
Starrett Co., L. S.

Indicators, Steam Engine
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Injectors
American Injector Co.
Lunkenheimer Co.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.

Lace Leather
Chicago Rawhide Mfg. Co.

Levels
Starrett Co., L. S.

Lubricators
American Injector Co.
Detroit Lubricator Co.
Greene, Tweed & Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.
Sterling Lubricator Co.
Williams Valve Co., D. T.

Lubricators, Automobile
Lunkenheimer Co.

Machinery, Oil Mill
Anderson Co., V. D.

Machines, Drilling
McCrea & Co., Jas.

Machines, Electric Boring
McCrea & Co., Jas.

Micrometers
Starrett Co., L. S.

Mill Equipment, Wire
Bates Machine Co.

Motors
American Engine Co.

Nail Machines, Wire
Bates Machine Co.

Nail Rumblers
Bates Machine Co.

Oil and Grease Cups
American Injector Co.
Bushnell & Co., John S.
Detroit Lubricator Co.
France Packing Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Oilers
Nugent & Co., W. W.

Oiling and Lubricating Devices
Nugent & Co., W. W.

Oiling Systems
Nugent & Co., W. W.
Burt Mfg. Co.
Pittsburg Gage and Supply Co.

Oils
Harris Oil Co., A. W.
International Boiler Compound Co.
Lubron Mfg. Co.
Standard Oil Co.
Vacuum Oil Co.

Packing, Metallic
France Packing Co.
Goodyear Tire & Rubber Co.

Packing, Rawhide Hydraulic
Chicago Rawhide Mfg. Co.

Packing, Sheet and Fibrous
Chicago Rawhide Mfg. Co.
Crandall Packing Co.
France Packing Co.
Goodyear Tire & Rubber Co.
Gould Packing Co.
Greene, Tweed & Co.
Lubron Mfg. Co.
Peerless Rubber Mfg. Co.
Patterson Co., D. S.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Robertson & Sons, Jas. L.

Packing Tools
Mound Tool & Scraper Co.

Paint
Dixon Crucible Co., Jos.

Pencils and Crayons
Dixon Crucible Co., Jos.

Pinions, Rawhide
Chicago Rawhide Mfg. Co.

Pipe and Fittings
Crane Co.

(Continued on page 58)

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Get a box today and enjoy the "HUM."

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Cor. Ninth and Cary Sts., Richmond, Va.
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(Continued from page 56)

Pipe Cutting and Threading Machines
Armstrong Mfg. Co.
Columbus Machine Co.
Toledo Pipe Threading Machine Co.

Planimeters
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Pumping Jacks
Myers & Bro., F. E.

Pumps, Air
Canton Pump Co.
Wheeler Condenser & Eng. Co.

Pumps, Centrifugal
Wheeler Condenser & Eng. Co.

Pumps, Oil
Greene, Tweed & Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Penberthy Injector Co.
Sterling Lubricator Co.

Pumps, Power
Myers & Bro., F. E.
Quincy Engine Wks.
Stewart Heater Co.

Pumps, Steam
Albany Steam Trap Co.
Canton Pump Co.
Lippincott Steam Spec. & Sup. Co.
Snider-Hughes Co.
Wheeler Condenser & Eng. Co.

Pumps, Vacuum
Wheeler Condenser & Eng. Co.

Rams, Steam
Penberthy Injector Co.

Reducing Wheels
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.

Regulators, Damper
Bushnell & Co., John S.
Lagonda Mfg. Co.
Robertson & Sons, Jas. L.

Regulators, Feedwater
Lagonda Mfg. Co.
Liberty Mfg. Co-

Regulators, Pressure
Foster Engineering Co.

Reseating Machines
Lagonda Mfg. Co.

Rope Dressing
Cling-Surface Co.

Rope Transmission Wheels
Bates Machine Co.

Rubber Goods
Goodyear Tire & Rubber Co.
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.

Rules, Steel
Starrett Co., L. S.

Sand, Fire
Presbrey Fire Brick Works

Saws, Hack
Starrett Co., L. S.

Separators, Steam and Oil
Albany Steam Trap Co.
Austin Separator Co.
Bushnell & Co., John S.
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
Lippincott Steam Spec. & Sup. Co.
Ohio Blower Co.
Robertson & Sons, Jas. L.
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Squares
Starrett Co., L. S.

Staple Machines
Bates Machine Co.

Steam Specialities
Anderson Co., V. D.
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Aultman & Taylor Mch. Co.
Model Stoker Co.

Strainers
Liberty Mfg. Co-

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Powell Co., Wm.

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Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Valves, Blowoff
Lagonda Mfg. Co.
Liberty Mfg. Co-
Pittsburg Gage & Supply Co.
Powell Co., Wm.

Valves, Gate
Golden-Anderson Valve Spe Co.
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Valves, Non-return
Golden-Anderson Valve Spe Co.

Valves, Pump
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Peerless Rubber Mfg. Co.
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Valves, Reducing
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Style No. 65
For cold water pumps and plungers.

If your packing is not up to the mark; if it develops a tendency to harden in the stuffing box, to char or burn, score rods or wears out too quickly

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Let us know what you want packing to do and we will send something that will produce results every time. Our new catalog, fully illustrated, will suggest the better packing for your use—shall we send one?

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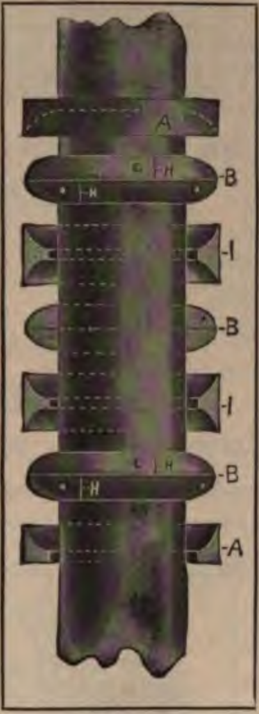

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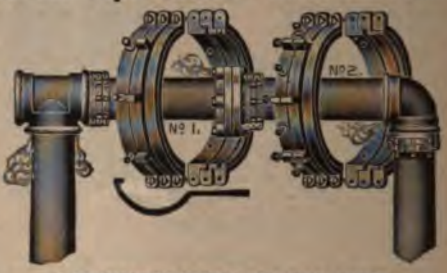

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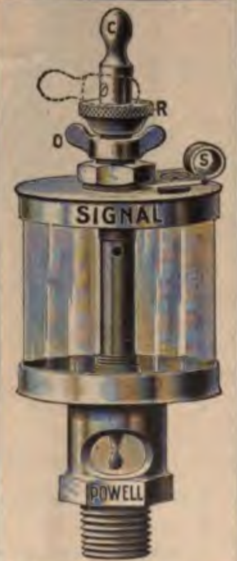
gh hole in the top plate,
s covered by snap lever
id can be swung aside
the right or left. Regu-
drops by knurled screw
," fasten it firmly with
jamb nut "O" and the
one. Could anything be
nple and convenient?

⁂

i want to stop the feed
signal lever "C" to a
il position as shown by
nes, to start the feed raise
r to an upright position;
tilt it to an angle of 45



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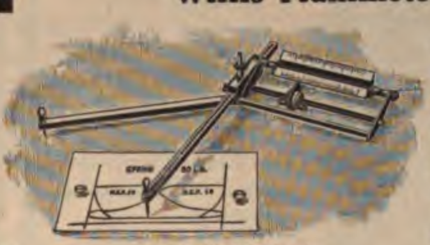

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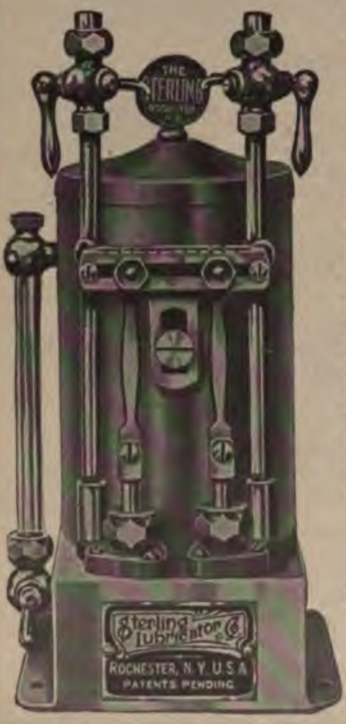
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150 to 160 lbs. st
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pressure and work
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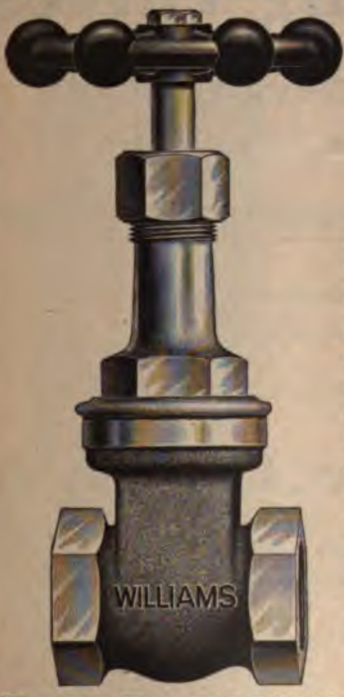

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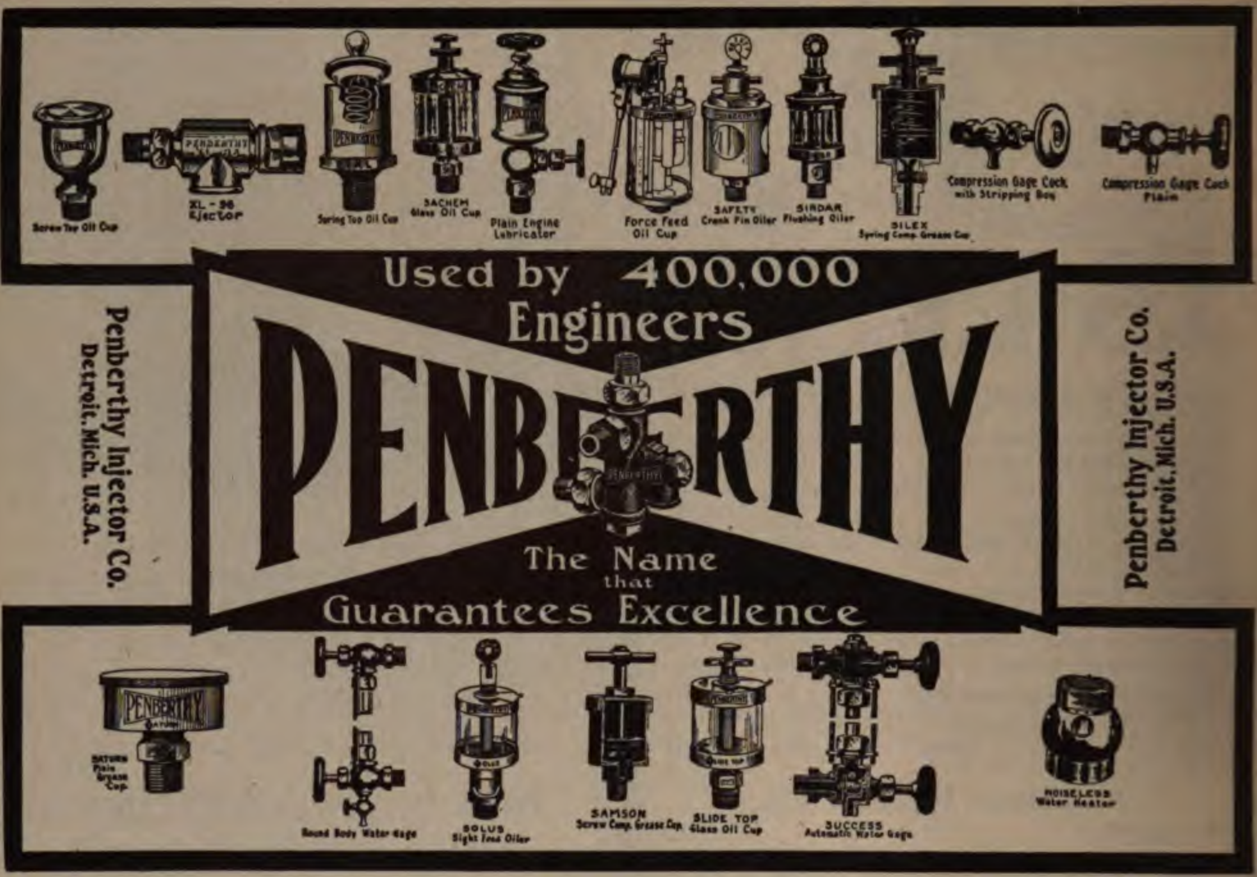

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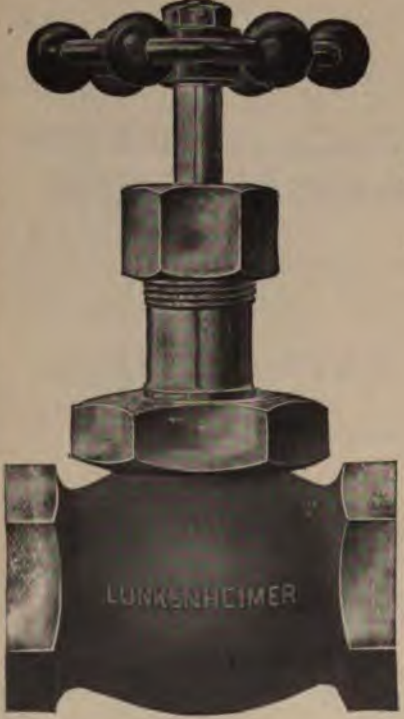

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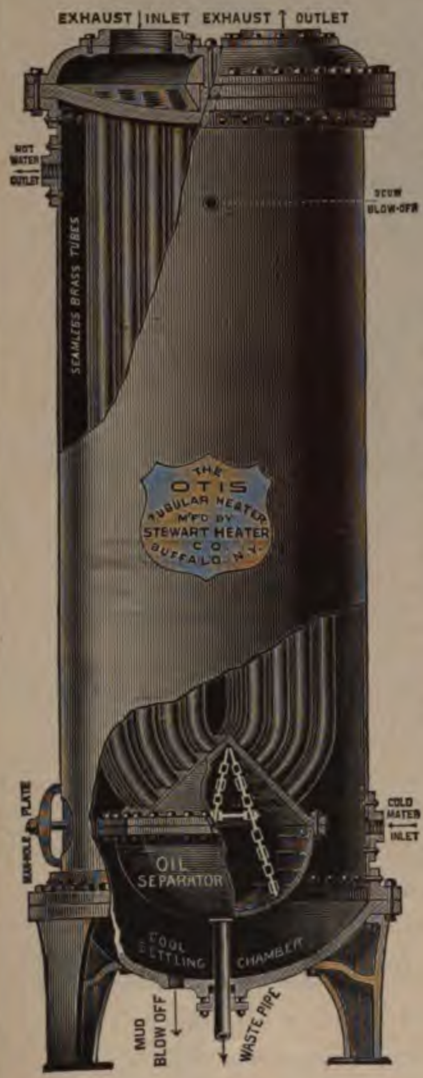

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Is guaranteed to heat the feed water to the boiling p
(210° or 212°) with the exhaust steam without caus
back pressure. It will also extract the oil from the
haust so that the exhaust steam can afterward be used
heating purposes and the water of condensation from
heating system be returned to the boilers free from oil.

TRY THIS HEATER. If it fails to give satisfact
in every respect it may be returned and we will pay frei
and cartage both ways and all costs of installation.

A Special Feature of Our Pump

While these pumps are of the double plunger ty
they can be run as double pumps or as two distinct sin
pumps.

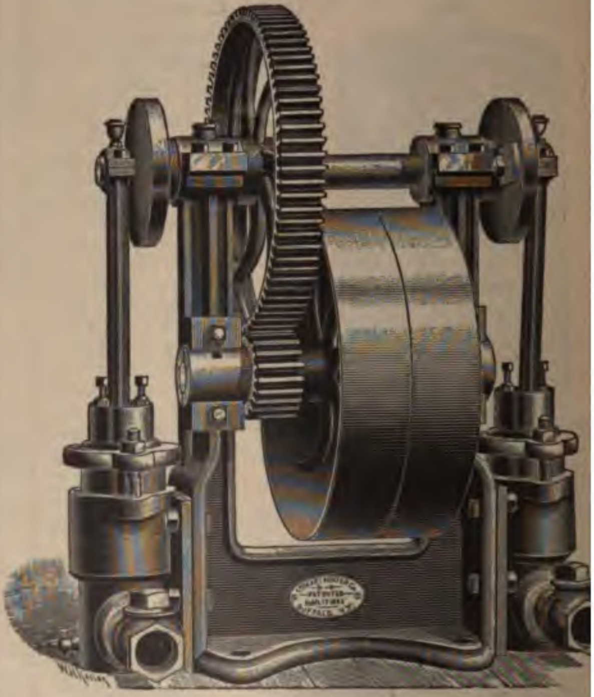
**THEY
ARE
SIMPLE**

The pump with the fewest working parts is the less liable to get out of order. For that reason we have designed our pumps along the line of simplicity.

Pump and Heater Catalogs with prices gladly furnished.

THE STEWART HEATER CO.,

160 Norfolk Ave. BUFFALO, N.Y.



No. 3 Double Plunger Pump.

THE NATIONAL FEED WATER HEATER

2,000,000 Horse Power in Daily Use.

The principal characteristics of these heaters are SIMPLICITY, CHEAPNESS, RELIABILITY and EFFECTIVENESS and full amount of heating surface in every heater.

Supplies Water to the Boiler at 212° F.

We manufacture the Original and Only Genuine First-Class Coil Feed Water Heaters.

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THE NATIONAL PIPE BENDING CO.

175 Lloyd St., NEW HAVEN, CONN.

We also manufacture all kinds of COILS IN IRON, BRASS AND COPPER PIPE

Catalogue and Prices on application.

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FREE INDICATOR

with our course of Indicator Instruction (by mail) will soon be withdrawn. If you are an engineer desirous of learning indicator work "to a finish," and wish to get a fine Indicator outfit to practice with, you should read our ad in the Engineers' Review for March, and then write for further particulars, which are free. Address

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You Can Serve Your Employer and Yourself Best

BY USING

CANTON PUMPS

They save your employer money at the start and keep it up by the economical use of steam and lack of repair bills. They save you trouble, work and worry.

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SEND FOR OUR CATALOG. IT IS HANDSOME AND USEFUL.

We have a special proposition that will interest every engineer who has any spare time. Other engineers are profiting by it. Why don't you? Write for full particulars.

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Mention the Engineers' Review when writing

CANTON, OHIO.

MONITOR DUPLEX STEAM PUMPS

Require less attention, fewer repairs and give better satisfaction than any other pump on the market on account of their

Simplicity, Durability and Reliability

THE MONITOR DUPLEX BOILER FEEDER

Diameter of Steam Cylinders	Diameter of Water Pistons	Length of Stroke	Capacity	
			Boiler Horse Power	Gallons per Minute Maximum
3	2	3	100	20
4½	2¾	4	200	40
5¼	3½	5	350	70
6	4	6	500	100
7	4	8	600	125
7	4½	8	750	160
8	4½	10	900	175
8	5	10	1000	215
10	5	10	1000	215
10	6	10	1500	325

For hot water boiler feeding under high pressure, the MONITOR DUPLEX OUTSIDE CENTER PACKED PUMP, illustrated below, is especially desirable.

All water valves are located above the cylinders, so that vapors due to hot water do not enter the cylinders, which insures quiet operation. All valves are accessible through hand holes located on top of the valve chambers.

THE MONITOR OUTSIDE CENTER PACKED PUMP

Our prices will be interesting to you

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Save Your Steam

BY USING A

FISHER GOVERNOR

on your Steam Pump. Positive in its action. Prevents an over pressure in the tank or discharge main. For Hydraulic Elevators, Fire, Boiler Feed and any pump where the discharge pressure is to be regulated. If you want to know more about them write.

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Class 'Q'

For low pressure or vacuum heating use a

FOSTER "CLASS Q" REGULATOR VALVE

works well at low pressure or vacuum. Parts are simple, amply protected and pressure can be absolutely regulated.

Class 'QH'

THE FOSTER "CLASS QH" VALVE

is especially designed as a vacuum valve, besides being a perfect low pressure regulator. Can be used with outlet pipe larger than the valve. Send for a Foster Catalog.

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Save Coal. Watch Your Ash Pile

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DOES not allow any fine coal to go into the ashpit. It burns it **all.** Will pay for itself several times over each season in the saving of fuel. **Put in a trial set now.** Burns **any** coal and is especially adapted for the cheaper grades, such as slack and screenings. No change required in your furnace. Anyone can set it in place.

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Armour & Co., Elevators	Chicago
Atlas Brewing Co.	"
Albert Schwill & Co.	"
St. Charles E.L. Plant,	St Charles, Ill.
Harlem Elec. Light Plant,	Harlem, Ill.
Alabama S.&W.Co.,	Birmingham, Ala.
Kokomo S. & W. Co.	Kokomo, Ind.
Dodge Mfg. Co.	Mishawaka, Ind.
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Rock Rapids E L. Plant	Rock Rapids, Ia.
Sleepy Eye Mil'g Co.	Sleepy Eye, Minn

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Is the first feature to consider in an economically and well conducted plant. We build

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which will give the highest efficiency both in fuel and in labor saving and will be absolutely smokeless. All of these boilers are equipped with the famous

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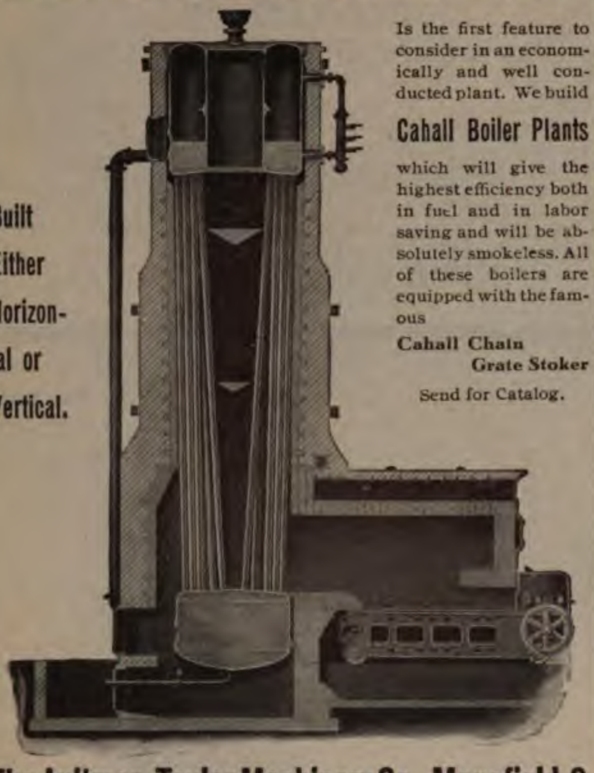
Send for Catalog.

Built Either Horizontal or Vertical.



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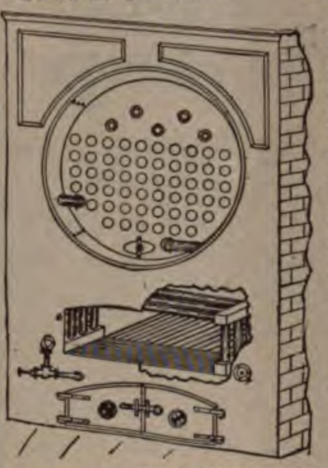
LAMPREY PROTECTIVE ARCH PLATES

SAVE FUEL. SAVE REPAIRS.



No burned out arches and cracked fronts if you use this device for protecting boiler mouths. Besides preserving the brickwork about the furnace fronts, it saves fuel and allows the utilization of heat otherwise wasted.

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Winston-Salem, N. C., Jan. 2, '03
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Dear Sirs: We have been using for the past sixty days, the Lamprey Protective Arch Plate which works to our entire satisfaction. Were we to put in another boiler, we should be sure to use this device.

Yours truly,
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ALSO ALL KINDS OF

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PATENT EXTENSION FURNACE
For burning sawdust, wood, waste and bogarse

Rotary Blochers and Pulp Digesters, Penstocks, Wheel Cases, Standpipes, Forgings, Castings, Grates, Bolts, Gaskets and Boiler Fittings.

INSPECTION AND REPAIRING OF BOILERS
given prompt attention by careful, competent workmen.

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Columbus, Ohio

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This Indicator may be run at highest speed required, without heating. The working parts are encased. Dial has two rows of figures, reading either right or left as shaft may run. Steel pointed spindle with rubber tips for both pointed and centered shafts. The 0 mark may be instantly set at the starting point.

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Has No Superior in Economy, Regulation and Durability.

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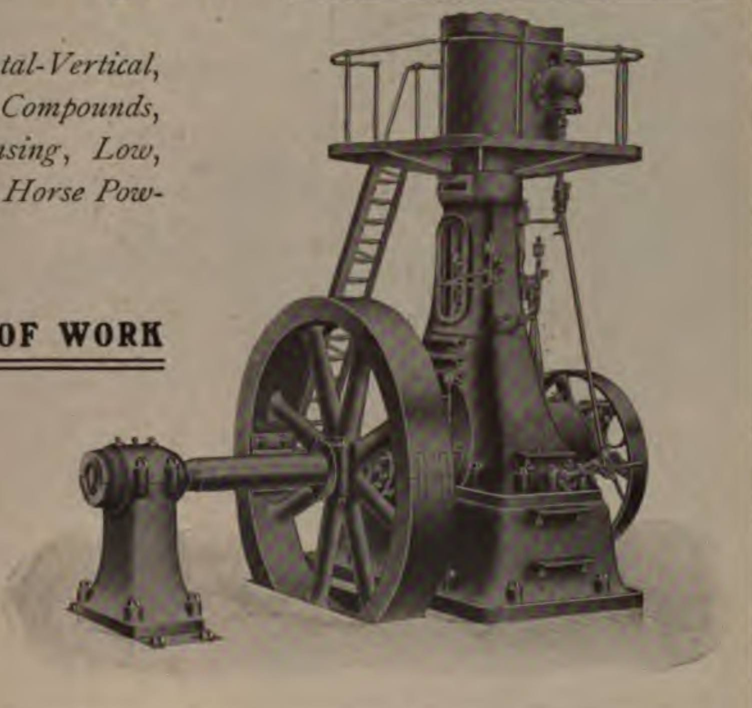

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If interested write for our new Booklet, "Corliss Engines"

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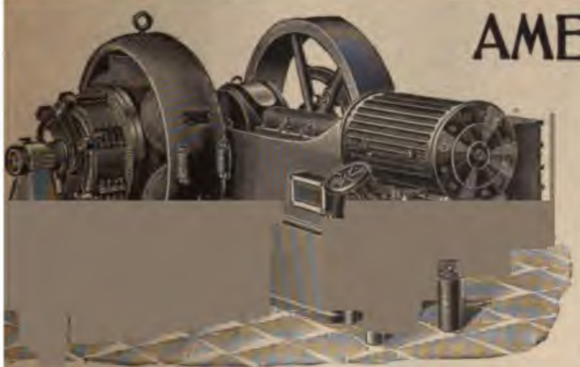

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American Engines lead in the markets of the world, and the AMERICAN-BALL DUPLEX COMPOUND ENGINE is at the head. It is a marvel of simplicity; requires no more floor space than a simple engine, and it **SAVES 25 PER CENT OF THE FUEL** without a condenser.

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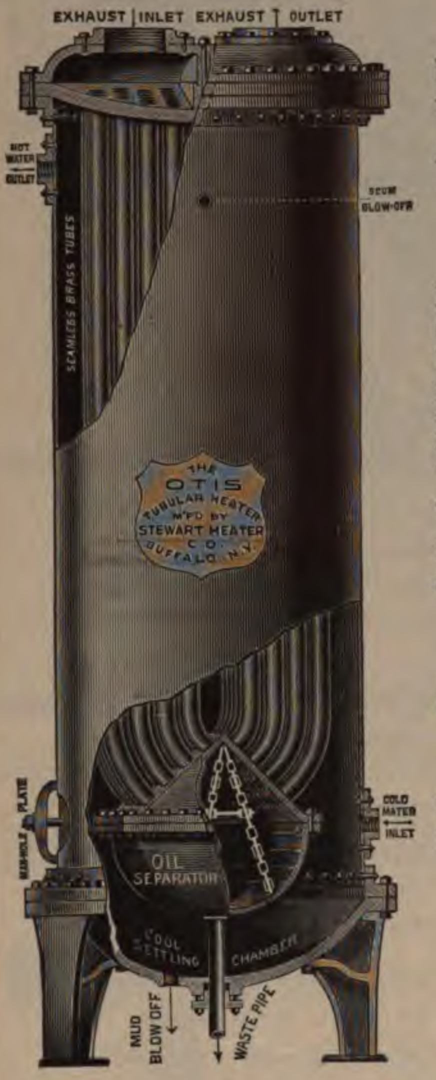

The Standard Otis Tubular Heater.

A feed water heater will put the water into yo
boilers at boiling point, thus reducing the amount of f
used. A good heater should pay for itself in a short ti

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Is guaranteed to heat the feed water to the boiling po
(210° or 212°) with the exhaust steam without caus
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haust so that the exhaust steam can afterward be used
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TRY THIS HEATER. If it fails to give satisfact
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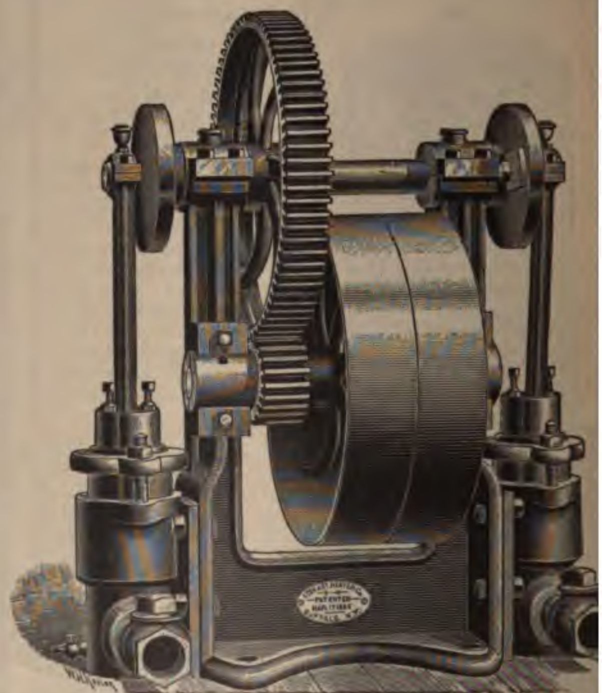

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The principal characteristics of these heaters are SIMPLICITY, CHEAPNESS, RELIABILITY and EFFECTIVENESS and full amount of heating surface in every heater.

Supplies Water to the Boiler at 212° F.

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We also manufacture all kinds of
COILS IN IRON, BRASS AND COPPER PIPE

Catalogue and Prices on application.

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They save your employer money at the start and keep it up by the economical use of steam and lack of repair bills. They save you trouble, work and worry.

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Require less attention, fewer repairs and give better satisfaction than any other pump on the market on account of their

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3	2	3	100	
4½	2¾	4	200	
5¼	3½	5	350	
6	4	6	500	1
7	4	8	600	1
7	4½	8	750	1
8	4½	10	900	1
8	5	10	1000	2
10	5	10	1000	2
10	6	10	1500	3

For hot water boiler feeding under high pressure, MONITOR DUPLEX OUTSIDE CENTER PACK PUMP, illustrated below, is especially desirable.

All water valves are located above the cylinders, so t vapors due to hot water do not enter the cylinders, which sures quiet operation. All valves are accessible through h holes located on top of the valve chambers.

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Our prices will be interesting to you

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For low pressure or vacuum heating use a

FOSTER "CLASS Q" REGULATOR VALVE

works well at low pressure or vacuum. Parts are simple, amply protected and pressure can be absolutely regulated.

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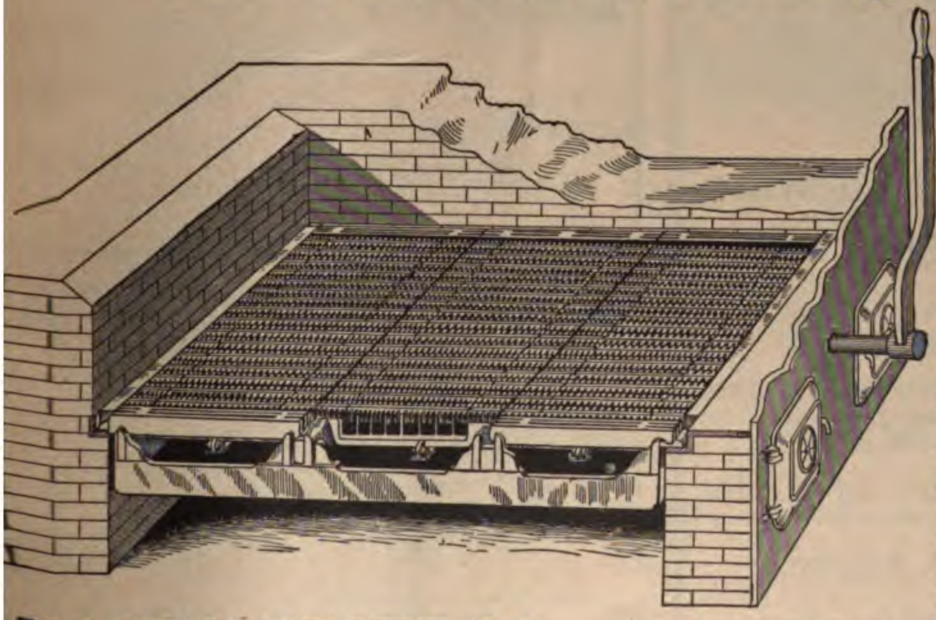
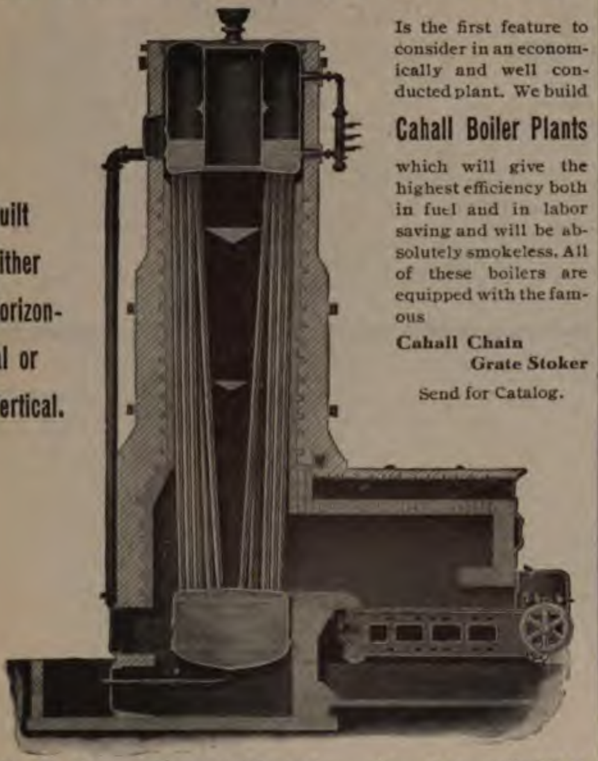
Bedford E L & Pow.Co. Bedford, Iowa
Rock Rapids E L. Plant Ro k Rapids, Ia.
Sleepy Eye Mil'g Co. Sleepy Eye, Minn

MARTIN GRATE CO., 83 Van Buren Street, CHICAGO



BOILER EQUIPMENT



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LAMPREY PROTECTIVE
ARCH PLATES
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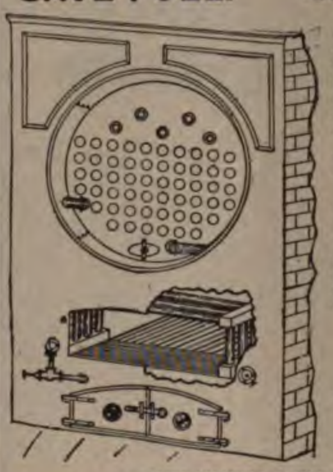

No burned out arches and cracked fronts if you use this device for protecting boiler mouths. Besides preserving the brickwork about the furnace fronts, it saves fuel and allows the utilization of heat otherwise wasted.

SHAMROCK MILLS.
Winston-Salem, N. C., Jan. 2, '05
The Lamprey Co.

Dear Sirs: We have been using for the past sixty days, the Lamprey Protective Arch Plate which works to our entire satisfaction. Were we to put in another boiler, we should be sure to use this device.

Yours truly,
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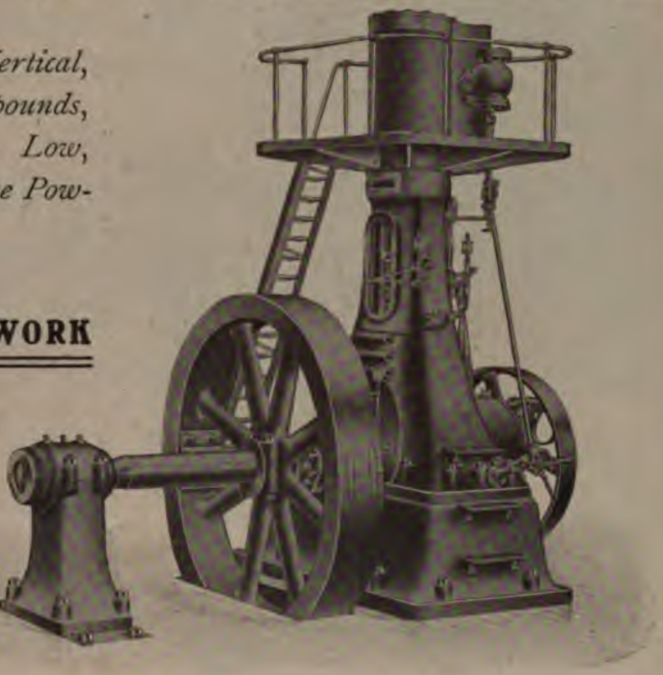

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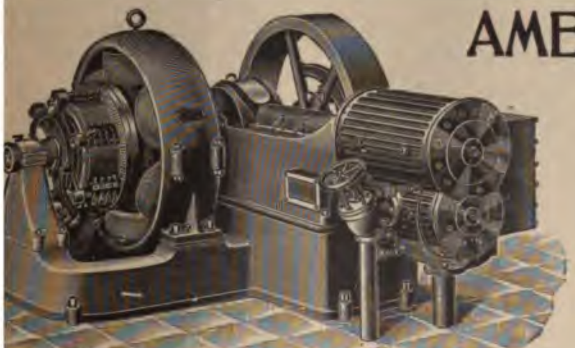

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We furnish Complete Plants, consisting of Engines, Generators and Motors—all of our own manufacture.

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Test of a 10½ and 20x14-inch Reeves Vertical Cross Compound
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Engine operating under 150 I. S. P. condensing into a 24-inch V
Mechanical efficiency, 96.5 per cent. The test shows this engine to

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Steam and exhaust pipes were small. The condensing run with but a 24-inch vacuum. There Reheating, or Steam Jacketing and the eng not specially prepared for the test.

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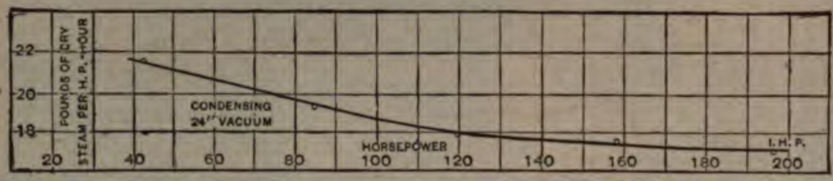

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HOUSTEN, TEX., Howard Smith Co.
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Simple and Compound.
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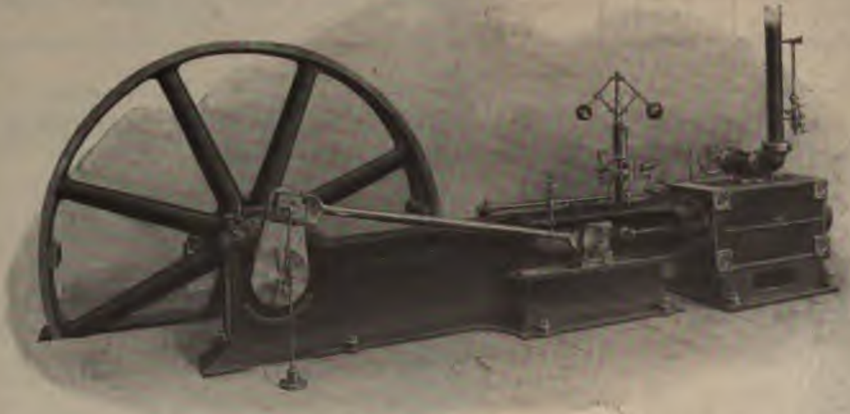

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us Prove it to you by Furnishing a Combination Heater for your Plant this Spring —Subject to Trial.

The COOKSON has many advantages over all others:

Maintains higher temperature of feed water without back pressure on engines. Constant temperature 204-212° F.

Will heat more water with less steam than any other.

The steam only that is to be condensed comes in contact with the water.

Thoroughly purifies and filters the feed water.

Has more lime catching surface and filtering capacity than any other.

It is the heaviest, most durable, most reliable and most accessible to clean of any. Made of the best of materials throughout. Finest grade of fittings.

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CLEVELAND, NOVEMBER, 1905.

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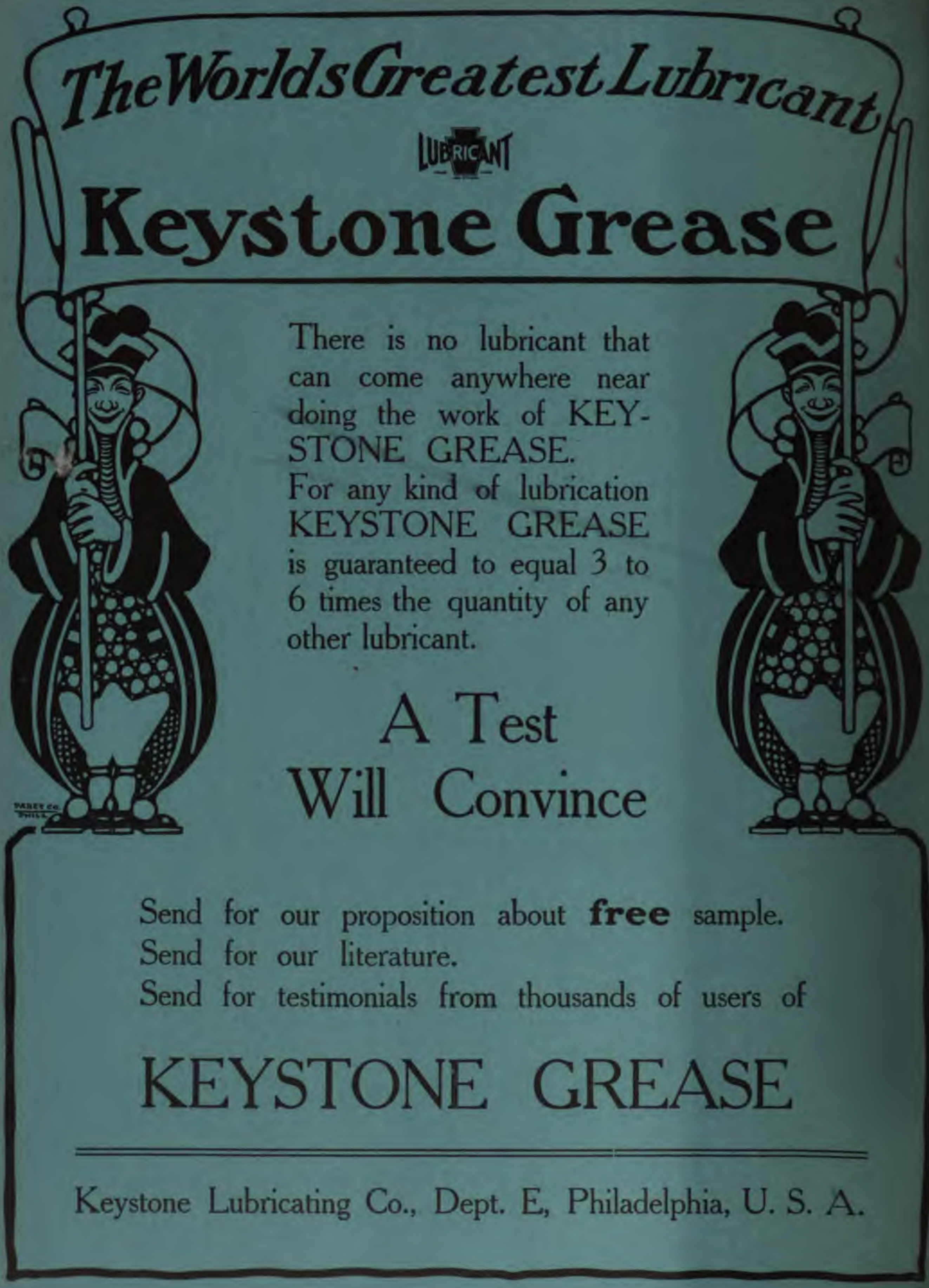

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ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

VOL. 16. CLEVELAND. NOVEMBER, 1905. No. 9.

BOSTON'S 72,000,000 GALLON PUMPING ENGINE.

The sewerage pumping engine, shown in Fig. 1, and erein described, is an addition to the pumping plant of he Boston main drainage works of the city of Boston, Mass. These works, which have been in operation for 20 years, consist of a system of intercepting sewers vhich have connections with and take the flow of the ommon sewer system, which is, in general, a comined system. The intercepting sewers take the total low of the common sewers except in time of rain torms, when the system becomes surcharged, then he connections with the common sewers are closed by automatic regulators, and they then discharge into the tide through their old outlets, these outlets being protected by tide gates. As soon as the storm ceases, or the flow does not exceed the capacity of the pumps, the regulators open the connections and the interceptors again take the flow.

The pumping station is situated at the end of the main sewer which receives the interceptors. The pumps raise the sewerage to an elevation sufficient to cause it to flow by gravity through the outfall sewer to the reservoir of 50,000,000 gallons capacity, where it is held until the outgoing tide flows, when it is discharged into tide water.

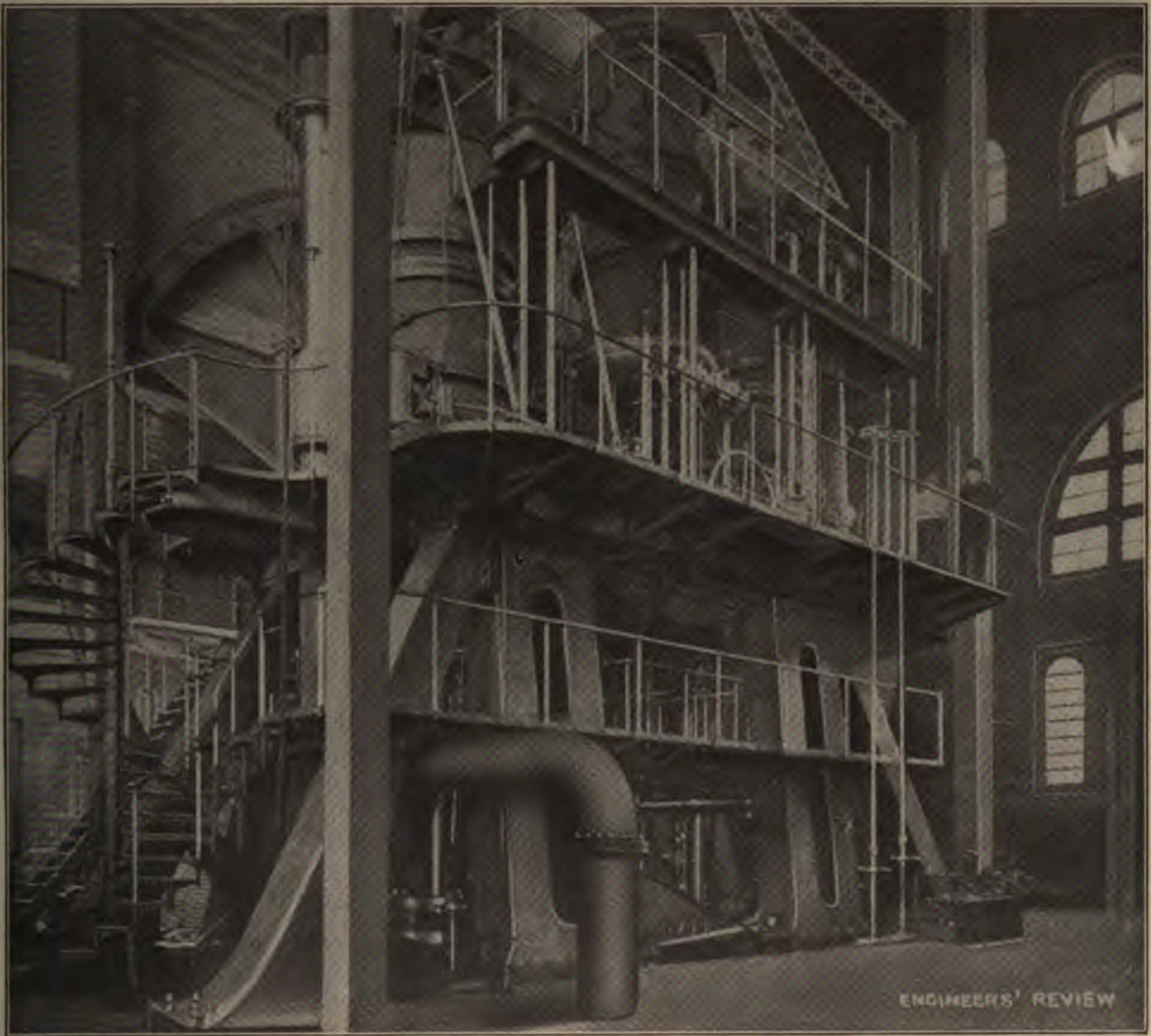


FIG. 1. THE 72,000,000-GALLON PUMPING ENGINE AT THE MAIN DRAINAGE PUMPING STATION, BOSTON, MASS.

The plant at the pumping station previous to the addition of the new pump, No. 5, consisted of two low duty Worthington pumps of a normal capacity of 25,000,000 gallons per day each, and two high duty pumps, of a normal capacity of 42,000,000 gallons per day each, designed by E. D. Leavitt, C. E. The Leavitt pumps are shown in Fig. 2.

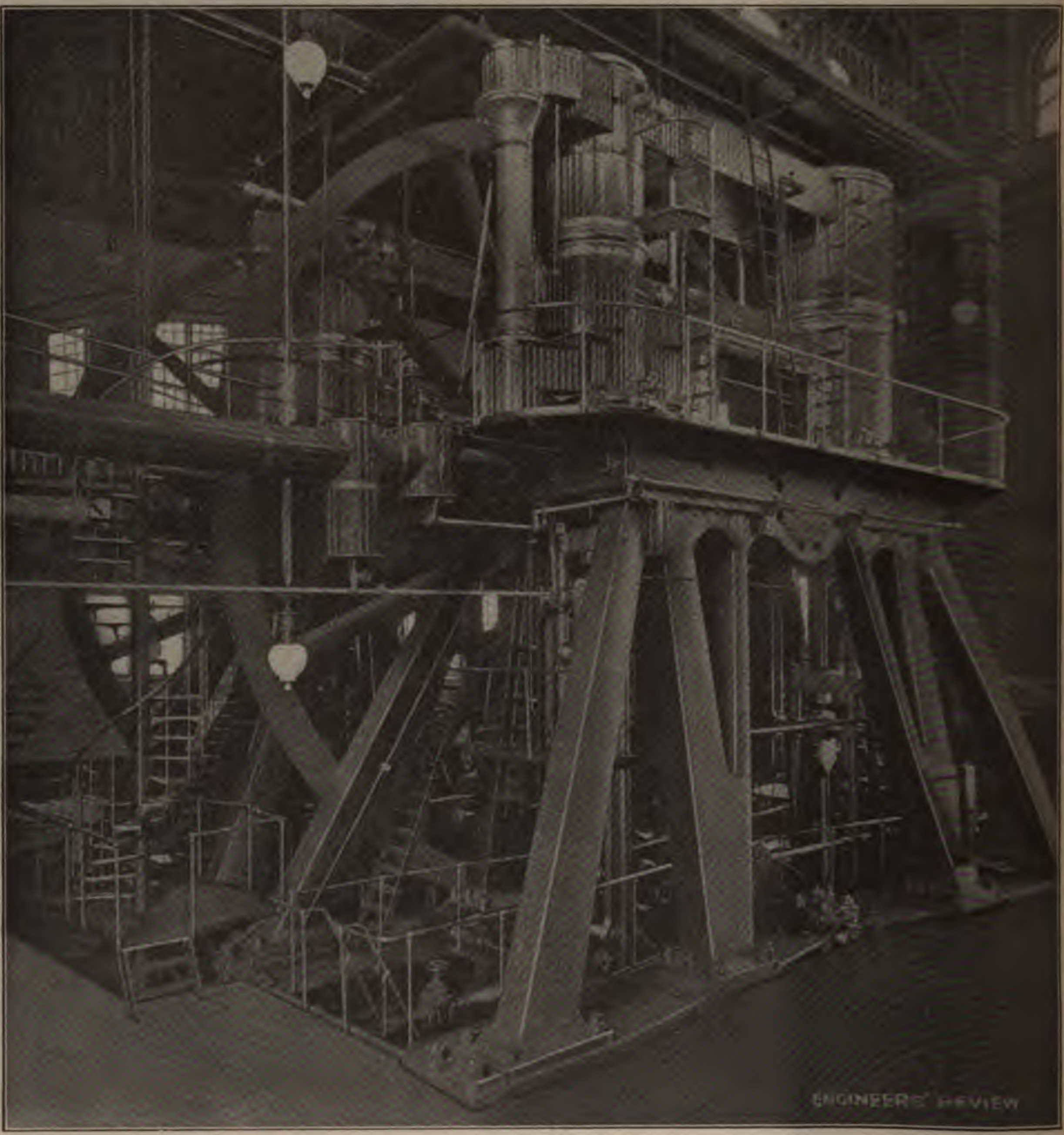


FIG. 2. TWO OF THE OLD LEAVITT PUMPS, EACH HAVING A CAPACITY OF 42,000,000 GALLONS PER DAY.

The new pump is also designed by Mr. Leavitt, and has a normal capacity of 72,000,000 gallons per day.

A general description of this pump, which is the largest pumping engine in the world, follows:

It is a triple expansion engine of the beam and flywheel type, with three vertical and inverted cylinders. The cylinders are set in two groups, the high and intermediate cylinders forming one group, the low pressure cylinder the other. The high pressure and intermediate cylinders are connected to one end of the beam and the low pressure cylinder to the other end. The pumps, two in number, are hung underneath the engine bedplate, directly below the two groups of steam cylinders, and are additionally supported by adjusting screws which bear on girders built into the foundation. The plungers are rigidly connected directly to the piston-rod crossheads of the two groups.

Centrally to the grouping of the cylinders and immediately above the floor level, is the walking-beam shaft carrying a double cast iron walking-beam, the ends of which are linked by double rods to the piston

ıead. A connecting-rod passes upward from
in on the walking-beam to a crankpin on the fly-
shaft which rests in two bearings, one in the en-
ure of the engine frame, the other being carried
ı independent outboard pier.

e steam valves are of the gridiron type and work
ve chambers traverse to the axis of the cylinder.
are operated by a cam gear, the cam shafts being
n from the crankshaft by a drag link lay shaft and
gearing. The cam shaft serves the intermediate
ɔw pressure cylinder and lies at right angles to the
shaft.

second cam shaft serves the high pressure cylin-
nd lies at right angles to the first cam shaft and
ven from it by mitre gears.

aw clutch is inserted in the first cam shaft, which
rowing out, disconnects the mechanism operat-
ıe high and intermediate pressure cylinder valves,
w pressure gear being left in action. A flywheel
nor attached to the engine base near the high
ıre cylinder, and belt driven from the main shaft,
ns the high pressure cutoff.

e cylinders are thoroughly steam jacketed all
on the heads and barrels, and tubular reheaters
ı lie between the high and intermediate cylinders
ıe intermediate and low pressure cylinders reheat
eam on its way from the high pressure to the inter-
ıte cylinder and from the intermediate to the low
ure cylinder. All hot surfaces are thoroughly
cted from radiation by nonconducting covering
a cast iron and sheet steel lagging, handsomely
ed.

ached to the engine is a jet condenser located
neath the main engine base casting, and hung
girders spanning the pit adjoining the main
well. The condenser is a vertical single action
t air pump, driven by links and a rocker shaft
the main walking-beam.

e pumps are single acting with plungers 60 inches
ameter having a 10-foot stroke. The pumps
in a wet well from which they take direct suc-
The delivery chambers of the two pumps are con-
d together and two discharge mains are con-
d to two 48-inch delivery mains, leading out in
ıite directions.

ch pump consists of 12 principal castings, *viz:*
suction boxes to which the suction valve seats are
l; four suction tubes leading to the suction box;
uction chamber to which the suction boxes are
l; one conical delivery chamber to which the de-
valve seats are bolted. There is also a delivery
ber made in two castings which also form an air
ber.

e pump valves in both the suction and discharge
are made of rubber, backed by rubber flaps with
osition backing plates loaded with lead and with
osition washer plates. They are rectangular in
. Each pump has 64 suction valves each hav-
port area of 67 square inches. This makes a sec-
f port area of 8,576 square inches in both pumps.
are 48 delivery valves of 75.16 square inches,
ge port area, making a total delivery area for
pumps of 7,215 square inches. The plungers of
ump, which are 6 inches in diameter work in
ıg sleeves which are 6 feet 2 inches long. The sleeves are lined with a composition having grooves turned in them.

The working steam pressure is 185 pounds per square inch above the atmosphere. The normal speed of the engine is about 17 revolutions per minute, at which speed the pumping capacity, by plunger displacements, is about 72,000,000 U. S. gallons in 24 hours. The static head on the pumps from the suction wells to the deposit sewer is ordinarily about 37 feet, but may at times be as high as 43 feet. The dynamic head is slightly greater. The leading dimensions of the pump are as follows: The high, intermediate and low pressure cylinders are 18½, 33 and 52¾ inches, respectively, with a stroke of 120 inches. The pump plungers, two single acting, are each 60 inches in diameter and have a stroke of 120 inches. The high pressure piston-rod is 4½ inches in diameter as is also the intermediate piston-rod. The low pressure piston-rod is 5½ inches in diameter, while the pump rods are 6 inches in diameter. The links are 10 feet from center to center, having a diameter of 4½ inches at the neck. The pins at the crosshead and beams are all 7½ x 7½ inches.

The connecting-rod is 16 feet 8 inches from center to center and 7½ inches in diameter at the neck. The walking-beam pin is 10 x 13½ inches and the crankpin is 12 x 13½ inches. The radius to the link pins on the beam is 8 feet, 6 inches, and the radius to the connecting-rod pin is 5 feet 8 inches. The diameter of the body of the main beam pin is 21 inches. The journals are 15 x 30 inches.

The main journal of the crankshaft is 19 x 38 inches. The outboard bearing is the same. The body of the shaft is 24 inches in diameter and the fit in the crank eye is 22½ inches in diameter. The diameter in the flywheel is 24 5-16 inches. The large eye in the crank is 39½ inches in diameter and the small one is 24 inches. The thickness of the web is 14¾ inches; the radius of the crank is 40 inches and the crankpin is 13 x 13½ inches. The flywheel has a diameter of 36 feet, having a rim 15 inches wide on the face and 15 inches in depth. The hub is 30 inches long. The wheel weighs about 55 tons net.

The lay shaft has a diameter of 6 inches; the cam shaft at its greatest diameter is 4 7-16 inches. The high pressure cylinder ports are ½-inch wide and the intermediate and low pressure ports are 1 inch wide. The high pressure inlet valve has a travel of 1⅛ inches, the intermediate and low pressure inlet valves 1 11-16 inches, the high pressure exhaust valve 1 inch and the intermediate and low pressure exhause valve 1 9-16 inches.

The inlet and cutoff cams have a throw of 1¼ inches and the exhaust cams ¾-inch.

The steam pipe has an inlet nozzle 5 inches in diameter and the high pressure exhaust pipe is 6 inches in diameter. The intermediate inlet pipe has a diameter of 8 inches, and the intermediate exhaust pipe is 10 inches in diameter. The low pressure inlet pipe is 12¾ inches in diameter and the exhaust pipe to the low pressure cylinder has a diameter of 15 inches.

The two delivery mains are 48 inches in diameter. The suction chamber is 5 feet 5½ inches x 6 feet 5½ inches made oval at the bottom, and 8 feet 2 inches x 9 feet 2 inches oval at the top outside

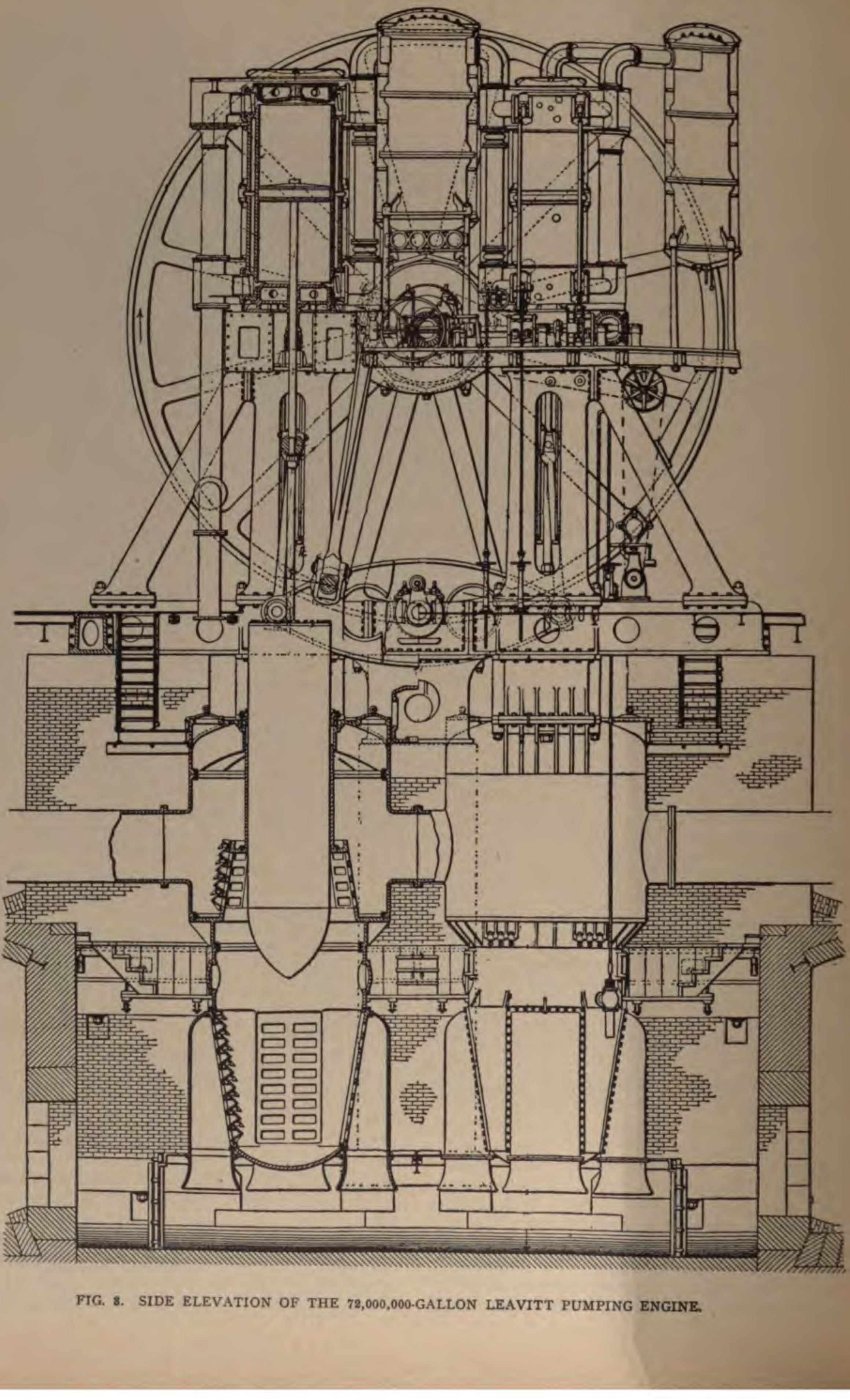


FIG. 8. SIDE ELEVATION OF THE 72,000,000-GALLON LEAVITT PUMPING ENGINE.

measurements. The delivery chambers are 12 feet, outside diameter.

The suction valve ports are 4 x 16¾ inches. There are 128 in both pumps. The delivery valve ports are 4 inches wide, varying from about 16⅜ inches to 19¼ inches long. The number in both pumps is 96.

The bedplate is made in several pieces and has a length over all of 42 feet x 16 feet 3 inches in width.

The air pump is a vertical single acting bucket pump, having a bore of 36 inches and a stroke of 24 inches.

Heights measured from the bottom of the main bedplate are as follows:

Up to the center of the the beam, which is also the floor line, 2 feet 6 inches.

Up to the top of the entablature at the valve gear; also the main gallery level, 18 feet 1.88 inches.

Up to the center of the cam shafts, 19 feet 4.88 inches.

Up to the center of the crankshafts, 19 feet 9.38 inches.

Up to the top face of the high pressure cylinder, 33 feet 3.76 inches.

Up to the top of the flywheel, 37 feet 9.38 inches.

Up to the center of the throttle valve, 30 feet 1.10 inches.

Down to the bottom of the cross bedplate, 5 feet 3 inches.

Down to the bottom of the pump chambers, 30 feet 6¾ inches.

Down to the bottom of the pump well, 35 feet 6 inches.

On account of the massive construction of the machinery, the large size and great weight of the individual parts, the transportation of this pump required special facilities. Some of the pieces were too large to ship by rail and were therefore shipped by water, a 1,500 ton barge being required Some of the weights

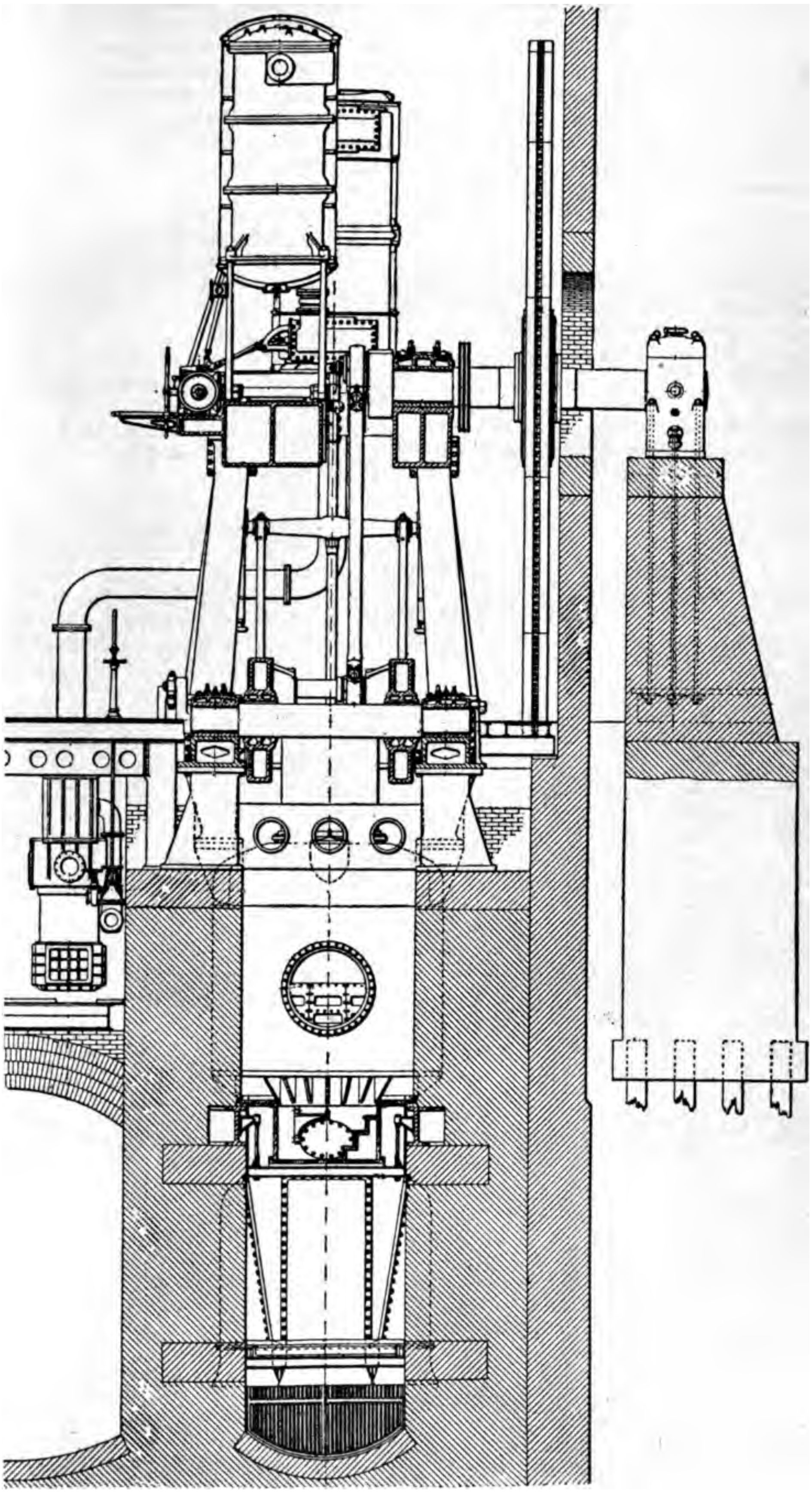


FIG. 4. SECTIONAL END ELEVATION OF THE SAME PUMP.

are as follows: Beams and pins 50,000 pounds, low pressure cylinder 40,000 pounds, beam pedestal bedplate 34,000 pounds, plunger 30,000 pounds, upper pump chamber 26,000 pounds, crankshaft 23,000 pounds, delivery seating 21,000 pounds, suction chamber, main columns and beam, each 17,000 pounds; the total weight being about 1,700,000 pounds.

There being no crane in the engine house, it was necessary to erect the machinery with hand crabs, and the entire pumping engine was transported and erected without mishap of any description.

The pump arrived in Boston in September, 1903, but it is so massive that it took a long time to get it erected and ready to operate. Plans for this machinery were begun late in 1899, and in January, 1900, the city made a contract with the I. P. Morris Co. of Philadelphia for building it.

The pump was completed in 1903. Its approximate cost, including foundations, force mains, plans and inspection, piping and wiring, was $342,000.

At eleven o'clock, February 14th, in the presence of a number of city officials and a few invited guests, Superintendent of Streets James Donovan opened the throttle which set this mammoth engine in operation.

EXPERIENCES ON THE ROAD.

Mr. H. L. Stephenson in *The Electrical Journal* of recent date, gives some interesting experiences of the road. The following extracts are taken from this article:

The charm of road work lies in its novelty. One never knows where the next day will find him. Without a warning he is off on a trip of hundreds of miles to put apparatus in satisfactory service that may be done with a word or to investigate trouble that will baffle the skill of the best engineers. No sooner is one difficulty adjusted and the matter straightened out to the customer's satisfaction than he is lost in another problem that at first appears to be beyond his power to solve.

A recent case of trouble with an engine will serve to illustrate the point. This particular engine was a small high speed, piston-valve type, direct connected to a 75-kilowatt lighting machine to be driven at 270 revolutions per minute. When this outfit was started and the engine given full steam pressure, the first speed would probably be 276, and as quickly as another could be taken, 281, then 287, 293, 297, 301, 310, continuing to creep up slowly. With any load from ten kilowatts up, the speed regulation was very good, but whenever the load was thrown off the speed would begin to creep. We ran it throttled until all of its parts had reached an even temperature, but with no better results. The engine-man then took out the valve to look for steam leaks, but it seemed to be in good condition and a trial showed that we had not improved it. An improvised device showed that the governor did its work so that it looked reasonable to believe, despite our indicator cards, that there must be some error in the valve setting. This was checked over, and the piston taken out and examined. We took cards until there was no more paper to fit the indicator. And so it went for three or four days, until we got hold of the theoretical curve such as engine builders send out as a sort of an advertisement.

In comparing the card with one of our no-load curves the trouble was as apparent as though it had been printed in words across the paper. The valve leaked steam. Taking the valve out for the second time, we peened the inside of the rings to spread them out, thereby increasing the pressure against the walls of the steamchest. We had solved the problem for engines are not made that run better than this one now does.

Elevator work is more or less troublesome because these motors are generally installed by outside firms and if anything goes wrong it is usually attributed to a supposed defect in the machine.

A short time ago the writer had to leave some important work to see what could be done with a small direct current motor in elevator service. On reaching the place he found all hands awaiting his coming and after being informed that the motor seemed to run away and that the brushes threw off sparks like a blast furnace, he was plied with the usual question, "What's the matter?"

The control outfit was a difficult make and the wires were so concealed that it looked to be a three or four hour puzzle to find out where they went. Before an actual demonstration was made a happy thought prompted an investigation of the brushes, and there they were, just half way between the neutral points so that running the motor in either direction produced a furious sparking.

Another similar case occurred where the man in charge of the installation insisted that the motor was wired according to the diagram and since the elevator ran about four times its proper speed, there was, therefore, undoubtedly, something wrong with the motor. Like the experience just cited there was little difference in the speed whether the car was going up or coming down. A drop across the shunt field revealed the trouble at once; the connections were such that less than 25 per cent of the line voltage reached this part of the motor, and when the foreman stated that he did not see how this could make any difference, it was necessary to make the changes in the wiring to demonstrate to him that there was nothing wrong with the machine.

A peculiar case with induction motors was one where the customer ordered the machine investigated. There was no complaint as to the machine itself, its service was excellent and there was nothing about it that would indicate that there was any trouble except that his monthly bill for this elevator was just double that of two similar elevators and he did not think there was enough extra service to justify such a difference in his bills. This two-phase motor was run on a two-phase three-wire system where the voltage between the middle and each of the outside wires was 220 volts and between the two outside wires, 310 volts. A voltage reading was taken at the motor at each of the two sets of terminals while the car was in motion which read alike on both phases. Nothing about the working of the mechanical end of this outfit suggested that this motor was doing more work than either of its neighbors, but to make sure of this, it was decided to make a test that would show the power used and the power-factor. To serve as a check, readings were taken on one of the other elevators before we put the instruments in the circuit of the disturbing machine. The results were identical with our previous readings on one phase, with the car going either up or down, the same thing was true on the other phase when car was going up. But on coming down the city of the meters was taxed to the utmost to rd just what was going on. Such an excessive flow irrent could only be accounted for by the supposi- that this phase of the windings received the volt- between the two outside wires rather than the 220 for which the machine was designed. A check ing of the voltage at the motor terminals showed this was the case, but that in our first reading of same voltage we had overlooked the fact that the ce for changing the direction of rotation could a change in the way the phases were delivered to notor.

telegraphic request, "Trouble with new trans- ier, send man at once," took the writer off once n 18-hour trip. The customer had installed this and on putting it into service it gave entire satis- on, but in two or three hours some one noticed ce pouring from the transformer house in such mes that it was thought the whole building was ire. An investigation showed that it was only new transformer and a careful examination re- ed nothing further than that the smoke came from grease and dirt burning on two of its low tension inals, which from all appearances had reached a erature far above 100 degrees centigrade. The idants were at a loss to account for this as these inals were joined together by a short copper strap were therefore necessarily at the same voltage and, ourse, there could be no heating on account of a t leakage of current jumping from one to the r. This transformer was of that type designed to either 110 or 220 volts on the low tension side, as it was operated on the latter voltage, this cop- strap put the two windings in series. The reader imagine the chagrin of the attendants when the ole was remedied by sand papering this strap and erminals and screwing up the bolts tight enough ake a good contact for carrying the current. As transformer was run with a load very close to its l capacity, we afterwards took the precaution to t an additional jumper.

man on the road is not very often permitted to rve the effect of a runaway engine or water wheel out being responsible, directly or indirectly, for iccident. A case of this kind, however, happened ong since, where a sudden load caused the gover- on a water wheel to run the gates wide open and they stuck. The man at the switchboard lost iead and made no attempt to disconnect the gen- ors from the line. Six miles away we could tell something unusual was wrong and twice the at- int there tried to disconnect his lighting circuit a plunger switch which would break a load of ilowatts at 2,200 volts, and while he did not have of this load at the time, the voltage was so high he was unable to break the arc. The incandescent s on that lighting circuit would have put the or- ry arc to shame until they either burned out or oded. At one residence the family was at dinner the broken glass from the lamps above the table noisily in a perfect shower upon the table. The rs did not have capacity to read what the voltage each. Outside of the loss in lights the system was only crippled to the extent of two broken down transformers, though there were 14 large ones on the line at the time.

It is no uncommon thing to nurse a piece of apparatus through the rush hours and then spend the rest of the day in tearing it to pieces and hustling to get it together for the heavy loads of the morrow. In the large cities where the electric cars must be kept moving and the light kept burning as long as machinery will deliver power at all, one takes chances that fairly startle one in the calmer moments of reflection.

An instance of this sort once happened when an engineer wandered aimlessly into a station where he had started a small rotary converter for street car work some 10 or 12 days before. He was very much surprised to find that with any load the brushes would spark viciously. Shifting them either way to find a better point of commutation made no improvement. The commutator was in bad shape, but even this failed to explain why the machine should behave in this manner when it had so beautifull handled a much heavier load only the week before. A couple of hours finished the day's run and a careful examination revealed the fact that only seven out of the 24 brushes were touching the commutator. For some reason the brush tension had been increased to such an extent that the brushes had been ground away until the nuts, which fasten the carbon to the copper shunts, would not let the brush slide farther down in the holder. The cause of the sparking on the heavy loads was clearly due to the lack of sufficient brush area for carrying the current. Since no extra brushes were at hand it took the best part of the night to smooth off the commutator and put the machine in a workable condition.

Another converter affair the writer walked into unexpectedly. The attendants were getting the machines started for the morning load and had two of the five 1,000-kilowatt machines in the station already on the line when both suddenly gave a groan and the direct-current breakers came out as though there had been a ground on the trolley. They quickly had one machine on the bus again, but when the second switch was thrown in, the sparks from the brushes on each machine would have done credit to a Fourth of July celebration. The machines seemed fairly to stand still until the direct-current breakers performed their duty. They were fortunate in selecting the right one of these two, and, getting the rest of the rotary converters on the line with it, they went through the rush hours without crippling the service. What really had happened was that one of the big alternating generators at the main station had been thrown on the high tension busses out of phase and in some inexplainable way the polarity of the one rotary converter had been reversed and throwing their direct current ends together made a short circuit that was worthy of being patented.

In the rules of the National Board of Underwriters, it is recommended that some point of the secondary winding of a transformer be grounded and following this out came near making trouble at one substation. The installation was the ordinary rotary converter, started as a direct current motor by a motor generator set. A synchroscope was used in synchronizing and was connected on the line side to two small transformers while the machine voltage was taken care of by a small auto-transformer of the style for mounting on switchboards. This ground wire had just been put on when the writer reached the station. He was in time to see the first machine tried, and pour forth a cloud of smoke equal to that from a big freight locomotive. One wire of the synchroscope was all but melted. This new ground completed a path that was virtually a short-circuit on the starting generator.

A paper of this kind would not be complete without mentioning some experience with the series fields of compound machines. Tell a road man that a motor's speed is not right or that a generator will not hold up its voltage and the first thing that comes to his mind is the series field. This seems a simple thing, but any one with road experience can cite a number of cases where trouble was due to wrong connections on this part of the machine. It is not at all uncommon to find machines that have been run so long at an excessive speed to keep up the voltage at full load, that the proper pulleys have been lost and when the trouble is discovered it takes a month or two before the change can be made and the generator belted properly.

Alternating current apparatus is not altogether free from this same trouble. A good example comes to mind in the case of a composite wound generator which had been in service for two years but only at the end of that time did it begin to receive any where near its rated load. A complaint was made that this machine would not hold up its voltage with the separately excited field having a drop of 110 volts direct current. As the reported full load voltage was not excessively low we concluded that a bad power factor was responsible for some of it and with that end in view an elaborate test was arranged to be taken in the presence of the officials of the power company. The engineer who went to the plant discovered that in all probability during the two years they had been running, the self-excited coils had been bucking against the separately excited winding and reversing this—well, the truth is, we do not care to hurt the feelings of any one by commenting on things of this sort. Reversing this cured the trouble.

In calculating the horsepower of tubular boilers, consider 15 square feet of heating surface as equivalent to 1 nominal horsepower.

To find capacity of tanks any size; given dimensions of a cylinder in inches, to find its capacity in U. S. gallons: Square the diameter, multiply by the length and by .0034.

THE IMPROVED BALL ENGINE.

With the moving of the Ball Engine Co. of
Pa., into their new shops they are putting upo
market a line of engines of an entirely new desig
covering a considerably larger range of size
heretofore, retaining every good feature that has
acterized their products, and which combined
numerous improvements, produces an engine
should meet the most exacting demands. Some
more important features are illustrated and desc
in this article.

In this new line of engines, which are both hor

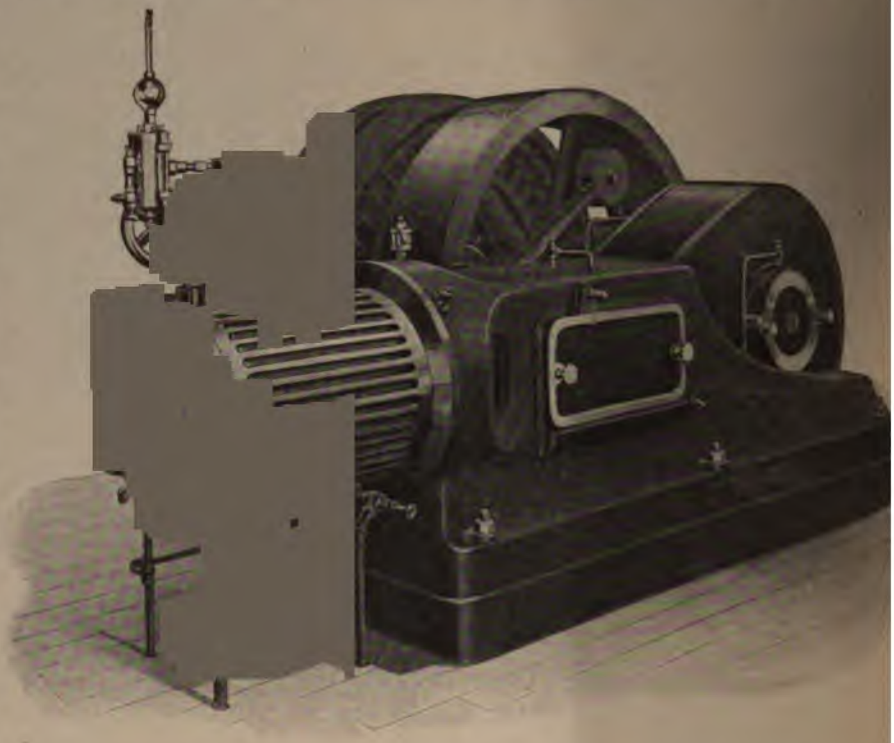


FIG. 1. SIDE CRANK SINGLE CYLINDER ENGINE DIRECT CONNECTED TO A GENERA

tal and vertical, the side crank type has been ado
thus avoiding the undesirable feature of an overh
ing wheel; also eliminating the necessity of three
ings in engines direct connected to generators, w
in many cases are sources of trouble due to the
culty in determining when they are in correct a
ment. With engines having the two shaft bear
however, there is no difficulty in preserving the a
ment so long as the shaft is kept square with the
ter line of the cylinder. Two projections are ca
the frame at either side of the main bearings and
behind the crank, which are planed off on a line
actly parallel with the center line of the cyli
These are to aid in keeping the shaft true. A b
formed on one side of the crank disk and a ga
furnished which can be attached to this boss and s
one of the planed projections referred to. The
turning the crank half way over, keeping all end
of the shaft in one direction, the gage shoul
brought opposite the other projection. If the e
is in line it will show alike on the two surface
if there is any misalignment it will be indicated.

arrangement there is no uncertainty when test- alignment at any time and it also makes the opera- very easy.

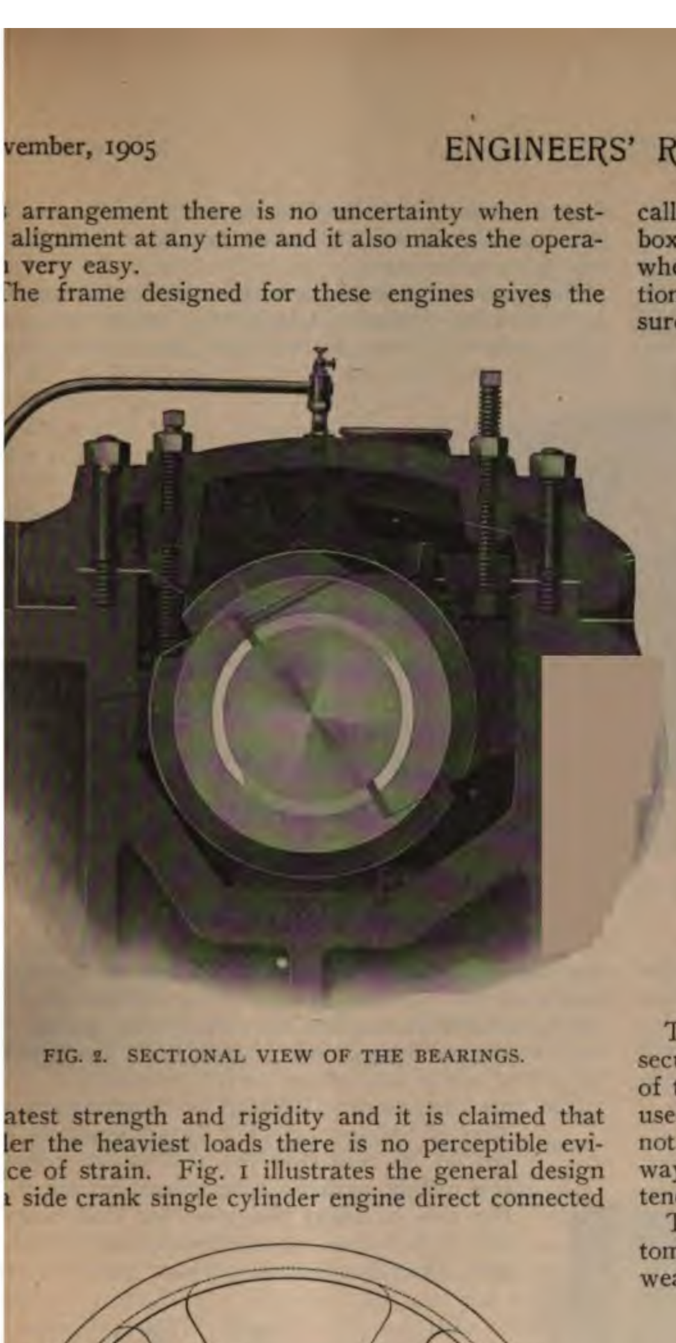


FIG. 2. SECTIONAL VIEW OF THE BEARINGS.

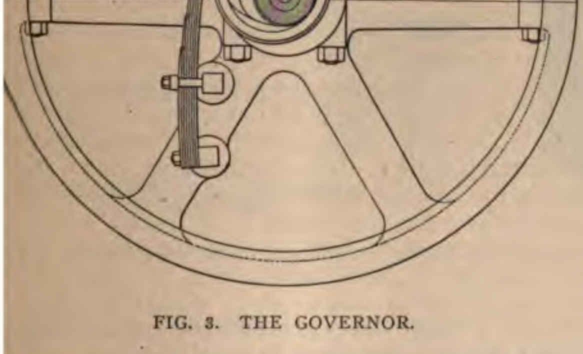


FIG. 3. THE GOVERNOR.

he frame designed for these engines gives the atest strength and rigidity and it is claimed that ler the heaviest loads there is no perceptible evi- ce of strain. Fig. 1 illustrates the general design side crank single cylinder engine direct connected generator. The main bearings Fig. 2, are of some- t unusual construction, combining the superior lities and simplicity of adjustment of the two-part with a more mechanical and rigid construction called for by the four-part bearing. In the four-part box the chief pieces are under pressure at the edge where the oil enters, resulting in difficulty of lubrication. In the half-box there is, or should be, no pressure in the joints where the oil enters, but if the box bears hard upon the shaft at the point where the oil has to enter heating is very apt to result. This is the case with the cheek pieces of a four-part box and consequently they can only be prevented from heating either by having them so loose, that the oil works in readily during a period that the pressure is reversed, or by delicately relieving the edge so as to make a gradual opening for the oil to be drawn in. There must be accurate provision for the oil to be drawn between the bearing surfaces and retained there as long as possible. In the Ball engine this is done to the fullest extent.

The design is such that for all possible conditions the lower box can be conveniently removed by slightly raising the shaft. The boxes are very solidly locked into position, yet may be readily adjusted while the engine is in motion. All the adjustments are in one direction, and the boxes do not have to be removed to take out shims.

In vertical engines, the lower half of the box is the only one adjusted, which permits of the cap being rigidly bolted down thereby adding stiffness to the engine base.

The crosshead is provided with babbitt-faced shoes, secured in a manner that prevents any possibility of their getting loose or being distorted by the means used in securing them. The adjustment for wear does not shift the shoes endwise, consequently they are always central with the crosshead pin, and there is no tendency to wear faster at one end than the other.

The crosshead pin is not flattened on the top and bottom as is usually done, but is arranged so that when it wears oval it can be turned through one-fourth of a revolution, thus giving it new surface for wear. The center of the pin is of forged steel and the outside is of a special mixture selected for its exceptional wearing qualities. These features together with the unusually copious lubrication provided for, practically elim-

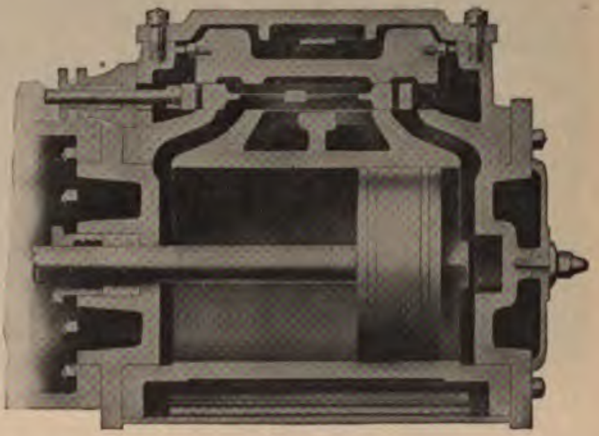


FIG. 4. CYLINDER, VALVES AND PRESSURE PLATE, SINGLE VALVE ENGINE.

inates the troubles ordinarily experienced with cross-head pins.

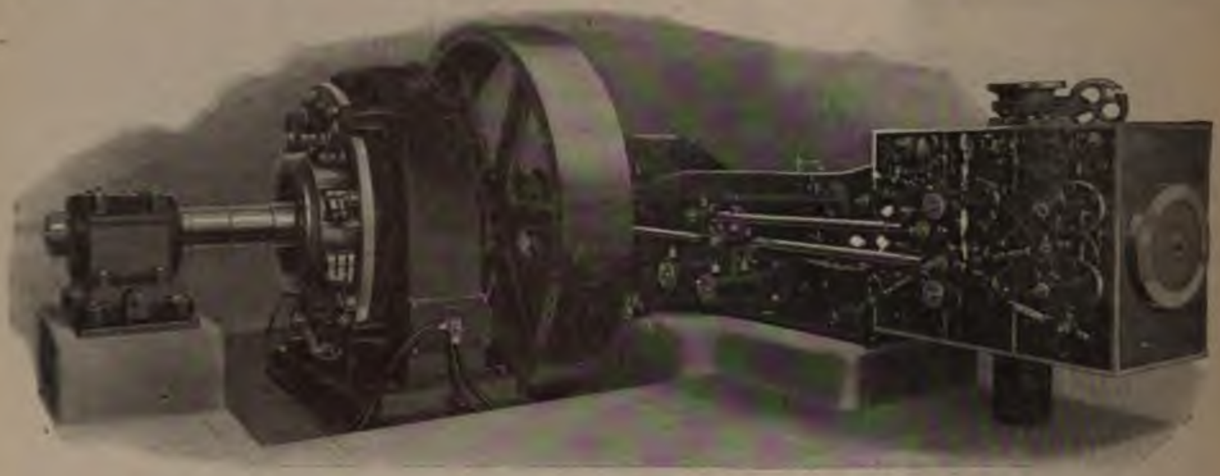


FIG. 5. HORIZONTAL CROSS COMPOUND SIDE CRANK ENGINE, CORLISS TYPE.

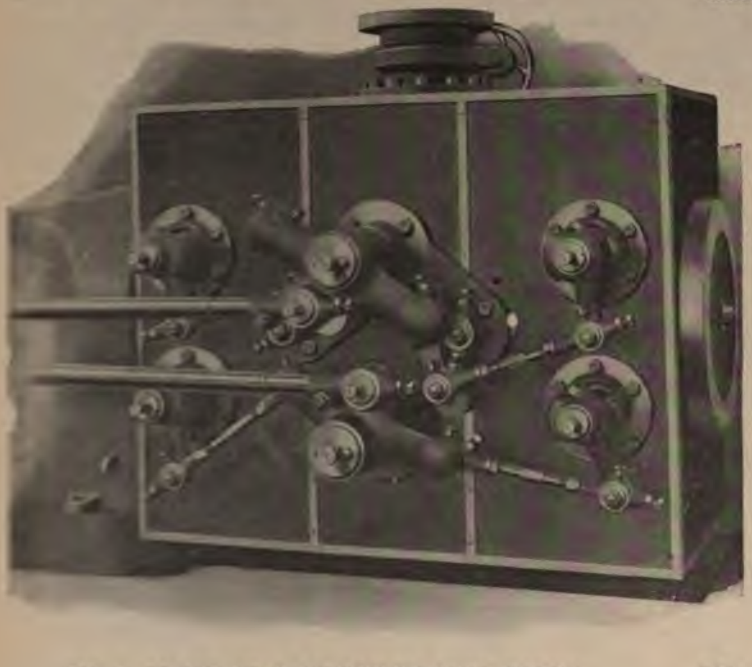


FIG. 6. VALVE GEAR OF CORLISS TYPE ENGINE.

The connecting-rod is of steel forging containing boxes at the crank end made of iron lined with hard genuine babbitt, and those at the crosshead end are of a special antifriction bronze. The adjustments are by means of wedges and bolts, the bolts being of a larger kind than are ordinarily used and are threaded entirely through the wedges. The crank and pin are cast integral, of a special mixture of steel and iron having great strength and possessing wearing qualities very far in advance of forged steel. This secures a large wearing surface for the crankpin and permits much larger shafts and pins than could otherwise be used. By eliminating the hole formerly used for the crankpin, a pin of much larger proportion may be employed, so that the practice is to make this fit larger than the diameter of the bearing which in turn enables the length of the fit to be safely decreased and thereby reduces the overhang.

The Ball engine, both the single and Corliss types are controlled by a shaft governor of recent invention. This governor is shown in Fig. 3, and is capable of meeting the requirements without giving trouble as time goes on. In this governor the centrifugal force of the weights is resisted directly by the spring, and not transmitted through any bearings. It has a powerful spring which means a powerful governor.

The speed is raised or lowered by changing the tension of the spring. The sensitiveness is controlled by removing the link which connects the weight and the eccentric in or out along the row of holes provided for that purpose. There is very little friction to this governor, and what there is, is of such uniform character that the governor is exceptionally well adapted to engines driving alternators in parallel.

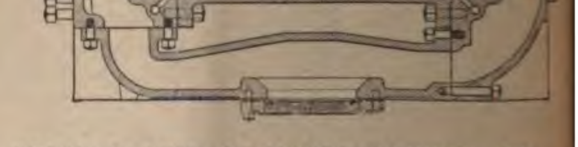


FIG. 7. SECTIONAL VIEW OF CORLISS CYLINDER AND VALVE.

The parts already described are particularly alike in both the single valve and Corliss engines. In the single valve engine the Sweet balanced valve is used. A sectional view of the valve and cylinder is shown ig. 4. The valve seat in the cylinder, the pressure e, and the distance strips which hold the pressure e just far enough away from the seat to permit the e to work freely but not steam tight, are all fin- d accurately. Practically the only wear of the e is downward, and this does not affect its tight- in any degree, any wear that may occur being lily taken up.

horizontal single cylinder side crank direct con- ed engine is shown in Fig. 5, in which the Corliss of valve is used, being driven by a type of gear ch retains the vital principles of the Corliss gear, without its limitations, dashpots not being required. he Corliss valves are unbalanced and are equipped the Armstrong non-detachable valve gear, by ns of which the valves are given a positive move- t, practically identical with that accomplished by ching gear and dashpots, the admission valves aining absolutely motionless at least half of the . The valve gear is shown in Fig. 6.

he admission valves are triple ported, thus permit- a very quick opening and closure without too d a movement of the valve. A sectional view of valve and cylinders is shown in Fig. 7. The ex- st valves are double ported but differing slightly the usual Corliss design in that they close off port on both sides of the valves and so reduce the rance space.

he single valve engines are built in sizes from 50 oo horsepower, and Corliss engines in sizes from to 1,200 horsepower. These engines are designed built by the Ball Engine Co., Erie, Pa.

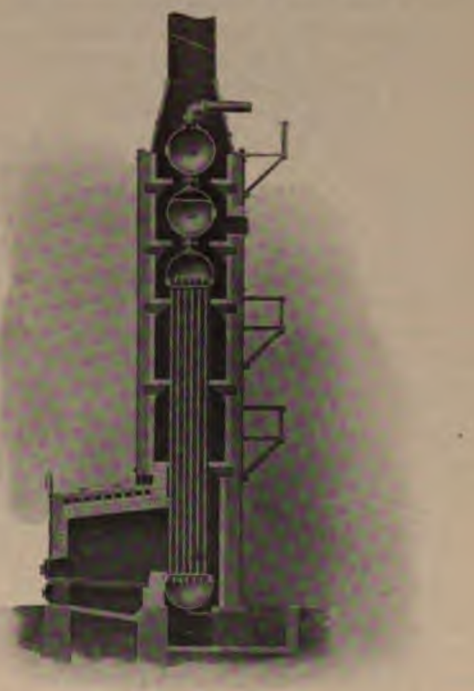
HE WHEELER WATER TUBE BOILER.

the development of the average steam boiler very attention has been paid to the matter of produc- a dry superheated steam. In the Wheeler water boiler the construction is such that the steam ns are in the line of the escaping flue gas and are cially designed to produce dry, superheated steam. claimed that the Wheeler boiler will show an iency of from 10 to 20 per cent over other boilers. nsists of an upper and lower tube drum 44 inches iameter which are connected by six rows of 4- tubes 22 feet long. Above and parallel with the r tube drum are two steam drums, one above the r, the lower steam drum being connected to the r steam drum by two 8-inch cast steel nozzles. ctly above these connections, the upper steam drum nnected with the lower steam drum by two 8- cast steel nozzles. At the top and in the center e upper steam drum is a cast steel nozzle for the n outlet.

the lower steam drum at each end, between the ing of the lower and upper nozzles are placed e plates which cause the steam to travel around end of each plate and come in contact with the surface of the drum. The boiler is enclosed in a wall 14 inches thick, which in the front and is 10 inches from the extreme diameter of the drum, and 15 inches from the bank of tubes, pt just opposite the combustion chamber, where enclosing wall is 18 inches thick, making a space o inches between the tubes and the wall.

e boiler is set in cast iron saddles under the ends of the lower tube drum, resting on the foundation walls, the ends of the two drums extending through the brick setting. Around the top of the upper tube drum is sufficient space to allow the boiler to expand. This space is filled with asbestos fibre.

The external combustion chamber has a crown 1-foot lower in front than at the tubes, the crown extending up against the tubes which are in straight rows, with 2½ inches between the rows across the tube drum, forcing the heat across the tubes and a part of it into the chamber beyond. Here it is caught by the first pair of baffles and is brought in among the tubes. The second and third pair of baffles hold it in among the tubes until it reaches the upper tube drum where it escapes at the sides around this drum and is caught by the baffles between the tube drum and the lower steam drum. It then passes around the steam drums up to and through the smoke stack. The course of the gases can be traced by referring to the illustration.



THE WHEELER BOILER.

Two doors are placed at each end of the boiler, the upper doors being just below the upper tube drum, while the lower doors are placed between the first and second baffles. Through these doors all the tubes may be reached with a steam hose or nozzle, which enables the engineer to blow out the soot, flue dust, and dirt which collects. There are platforms at the back of the boiler, one at the top under the steam line and one extending around the two ends of the boiler under each of the two upper doors for blowing the dust off the tubes.

A hood made of heavy plates drawn in at the top to fit the base ring of the stack is placed on top of the boiler, resting on the brick work. This is square at the bottom and round at the top and is securely anchored to angle irons at the corner of the brick work holding the hood and stack in place without the use of guy lines. The flat surface of each of the tube drums is reinforced between each row of tubes with a cast steel crown bar bolted to the tube plates with five 1-inch crown bar bolts. The longitudinal seams are double riveted and the boiler throughout is constructed for a working pressure of 165 pounds per square inch. Cast iron is not used in the construction of the boiler proper, the only instance being the front and doors and the frame set in the brick work, which are of ornamental design.

Both tube drums may be entered and the tubes and drums cleaned, without the annoyance and expense of moving and replacing two or three hundred manhole plates and the regrinding of these plates, or the fitting of gaskets to make them tight, by the removal of two handhole plates. The tubes being in straight rows and with doors so located for blowing off dust that the tubes may be reached with the steam hose and nozzle, the whole steam surface of the boiler including the top of the lower drum may be easily kept free from dust and at its highest efficiency. The space between the brick setting and the boiler with suitable doors for entering the same permits the workmen to examine any part of the boiler when it is being cleaned and allows ample room for making repairs in case they are necessary.

The heads are dished to a radius equal to the diameter of the drum in which they are used and there are no braces or stay rods needed or used to give them additional strength. The manholes are lipped in, and the tubes expanded in the tube plate by roller expanders and then beaded over onto the plates.

This boiler is manufactured by the Sharon Boiler Works, but W. W. Shilling, Chestnut street, Sharon, Pa., has charge of the sales department, and will furnish complete information to anyone who writes him.

THE POWER PLANT.

[Extracts from a paper read by Fred N. Bushnell before the American Railway Mechanical and Electrical Association, Philadelphia, Pa., Sept. 25-28, 1905.]

Since the advent of the direct connected generator the tendency in power station design has been toward a more systematic and compact organization of the generating apparatus, and the utmost simplification of the entire plant, consistent with the highest efficiency. The practice of different engineers has gradually worked toward the type of station which is now so generally adopted for street railway work. The standard practice in modern power station engineering embodies the following principles: Simplicity of design, subdivision of the plant into separate sections, so as to localize the effect of trouble to any part of the generating apparatus; and provision for the symmetrical extension of the plant to provide for future requirements.

While the unit system is now almost universally employed in the large power stations, it is usually somewhat modified for smaller plants, where the liability to interruption of the service is not so great, or the result so disastrous.

At the present time, alternating current generating stations and distributing systems are regarded as the most efficient to install in large cities where heavy traffic is distributed over a very large area, requiring current to be delivered to the line at a number of points, and where the interest upon the investment in direct current feeders and cost of their maintenance would amount to more than the same charges, plus the conversion losses in an alternating current system. The use of alternating current apparatus has steadily increased since its introduction, until at the present time approximately 60 per cent of the total power used by electrical railways in the United States is generated by this type of apparatus.

In designing a power station, the primary object in view is to deliver power at the bus-bar for the least expenditure of money, due importance, of course, being given to reliability of operation, which is the controlling principle in power station work.

Electric apparatus has now been developed to such a state of perfection, that in a well designed and carefully managed power station over 90 per cent of the power of the engine is converted into electric energy, and delivered to the transmission system for the operation of cars. It appears, therefore, that no very great gain in coal economy is to be expected from the further improvement of electrical generators, or switching apparatus, and engineers are directing their efforts more than ever before to the steam portion of a power station, which offers a more promising field for a reduction in the cost of power.

The number and size of units to be installed is one of the most important problems bearing upon fuel economy which the engineer is called upon to solve. In order to obtain the maximum efficiency from the prime movers and their auxiliaries, it is necessary that they should be proportioned to the loads they are intended to drive, so that if possible, they may be operated at all times at, or near their rated capacity.

The type of apparatus to be used, with alternating or direct current will not materially affect the design of the station, except in so far as the question of the use of a reciprocating engine or the steam turbine is involved. Up to this time, the steam turbine, which is rapidly growing in favor for electrical work, has been designed almost exclusively for use in connection with alternating current generators, and the manufacturers of electrical apparatus have held out scant encouragement that its speed could ever be so modified as to make its use with direct current generators, particularly with the larger size, practicable.

Reciprocating engines have, therefore, been regarded as the only type of steam motor available for this class of work, but it is interesting to note that considerable progress is being made in the development of direct current turbo-generators. And there seems to be good ground for belief that this problem will be successfully solved, and that in the near future this type of apparatus will be available in sizes as large as are generally required for direct current work.

It is to be regretted that most of the data upon efficiency of steam turbines has been derived from tests covering very short periods of time, usually only a few hours, and that so little data is available for their performance under actual service conditions. To the street railway manager or engineer, power station records for long periods, showing the coal consumption per kilowatt-hour, or, better still, the efficiency of the plant expressed in the percentage of heat energy in the coal converted into electrical energy at the switch-l, are of much greater interest and value than ecords of any number of short time tests for steam umption only, as it provides him with a much more ical means of making comparisons with the per- ance of other stations with which he is familiar. lata which has been published illustrating the rel- economy of steam consumption of turbines and rocating engines rarely ever shows comparisons een units operating under identical conditions as eam pressure, superheat, or vacuum, and there- does not fairly represent the relative performance e two types, and, too, the steam consumption of iaries is also invariably omitted, so that it is im- ble to form an intelligent opinion as to the addi- l cost of the higher vacuum required for the tur-

fortunately, superheated steam is now known to ather expensive to produce, particularly at the er temperatures, and consequently economy in n consumption does not necessarily mean economy e consumption of coal. The chief advantage in e is obviously in the saving which can be made at oal pile, and unless this saving can be shown to ufficient to pay for installing and operating the ssary superheating devices, it will be extremely to convince a careful street railway manager that l be profitable to use it.

a number of instances, the use of superheated n has been discontinued; either on account of the anical difficulties or because there was not a suffi- saving in coal to keep them in service. In other , no mechanical difficulties have been experienced he saving of coal has been all that could be rea- bly expected. At this time the weight of opinion s to be in favor of a moderate amount of super- say not exceeding 125 degrees.

rhaps the most difficult problem to be solved in ection with the power station is to secure proper tion to details of operation by the subordinate em- s. It will be practically impossible to maintain er discipline if among employes there are those feel a certain sense of security in their position igh the influence of someone higher in authority the man in charge of the station.

e work of all station employes should be system- l, the watch engineer should report in writing to ngineer in charge details of the apparatus which s judgment require attention. It is necessary all subordinate employes should be under con- supervision to insure a proper attention to their s, and this is especially true of fire room forces. is in this department that the greatest losses will through indifference on the part of the attend- and it is therefore, of the utmost importance that work should be carefully done. The only way to nplish this, known to the writer, is to place this tment in the immediate charge of an intelligent apable man, whose salary and the knowledge that ermanency of his position will depend upon the produced will be sufficient for him to keep con- y in touch with those under him and to insist their performing their duties properly.

most power stations records are kept of the coal water consumption, the temperature of the feed- and flue gases, and the station output, by which erformance of the station from month to month can be compared. These records furnish a check upon the condition of the station, the manner in which it is operated, and assure its being maintained in a high state of efficiency.

REPRESENTATIVE MEN FROM THE ENGINE ROOM, 27th—Edward Augustin.

The subject of this sketch, Edward Augustin, was born in Saxony, Germany, 32 years ago, coming to this country in 1880. He attended school just long enough to find how disagreeable young America can be to a greenhorn. His parents being in poor circumstances, he left school in a few months, and at the age of nine years started, in a rolling mill, his struggle for bread and existence. After two years, the rolling mill closed down and he secured a position as office boy in the counting room of the *Omaha Bee,* Omaha, Neb, serving in every department of that newspaper until he was transferred to the power department. Here he took up the fire shovel at the age of 16 years, leaving nine years later as the engineer. This was a training in office building work, including elevators, dynamos, motors and all that goes with a modern office building power plant, and valuable experience was obtained. He next drifted into the hands of an erecting engineer for a large ice machine company, and soon after was night engineer at the Omaha Cold Storage Co. Five months later, desiring a change of scene and surroundings, he secured the position of chief engineer for the Beatrice Creamery Co., to take charge of the Littleton creamery, Denver, Colo., the finest and largest creamery building in the world, which was then building. After the completion of this plant, Mr. Augustin took up the work of overhauling and erecting

EDWARD AUGUSTIN.

the plants of this company, scattered over the country.

Mr. Augustin believes his success is due to his early years spent in the newspaper business, where everything is touch and go. Being deprived of a school education, observation and contact with well-posted people have enabled him to make his way in the world. His maxim is "Figure from cause to effect, and effect to cause, and be faithful to your trust."

It can be truthfully said of Mr. Augustin that his heart and engine room are always open to a brother engineer and his hand extended to help any who are struggling to climb.

Explosion in the Flat Iron Building.

A terrific explosion in the basement of the Flat Iron building caused a panic and much excitement in the neighborhood on the night of Oct. 16. At the minute of the explosion all the lights in the huge structure went out, the first time that this building has ever been dark since its erection.

Because of the absence of lights and the shock of the explosion many persons in the structure rushed for elevators and stairways and made their way to the street. The blowing out of a boiler tube in the subbasement, two stories below the street, filled the boiler room with steam, scalding two men seriously and others badly. To add to the excitement a flood of water began pouring into the subbasement, while the rescuers were searching the boiler room for more victims.

To add to the chaos in the subcellar, several rescuers fainted from the heat, the temperature of the room being 138 degrees. These men were carried to the street and revived. The explosion is attributed to the employment of new men after the strike several weeks ago.

Open Knife Causes Accident.

An open pocket knife caused a bad accident at the Cedar avenue power house of the Cleveland electric railway Oct. 25, and Evan Williams, electrician, is at Emergency hospital burned about the face, hands and arms. Although he will recover, he will probably be disfigured for life.

Williams was working around one of the big dynamos. He had been using his knife and neglected to close it when he returned it to his pocket. Somehow he made a contact with the knife blade and the current, in a flash of flame, leaped from the dynamo to the knife. Williams was shocked into helplessness. He fell into an 8-foot pit at his side, through which live wires ran, but was saved from instant electrocution by the fact that a board on which he had been standing fell with him, and on this he landed. When fellow workmen rescued him from the pit, after the power was shut off, his clothing was ablaze.

The important part which rivets play in the construction of modern steel steamships is well illustrated by the fact that in the new Cunard liner Caronia, the largest ship ever constructed in Great Britain, no fewer than 1,800,000 rivets were used, the total weight represented being about 600 tons. The greater part of the riveting work was done by hydraulic power.

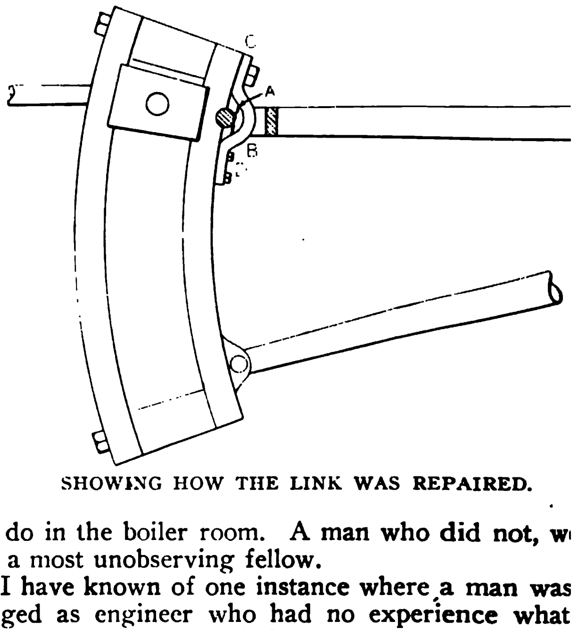
THE IDEA·EXCHANG

We would like the address of F. L. Smith,
Potter and G. H. Atkinson.—Editor.

How a Link was Repaired.

Editor of the Engineers' Review:

I was somewhat impressed in reading the lette
F. H. King on page 21 of the July issue, wher
states his belief that it does not stand to reason
man has ordinary intelligence, that he can take ch
of an engine and know nothing about the boiler p
He further says he does not believe a man who k
nothing about boilers could get a position as an
neer unless it was under the eye of a chief. I t
Mr. King comes very near the mark. I fail tc
how a man can work around a steam plant in any
city without getting some knowledge regarding
boiler plant although he may have nothing what



SHOWING HOW THE LINK WAS REPAIRED.

to do in the boiler room. A man who did not, w
be a most unobserving fellow.

I have known of one instance where a man was
gaged as engineer who had no experience what
either in the engine or boiler room. He was, howe
an intelligent man and after running two weeks
an engineer, was left in charge of the plant, an
far as I have ever been able to learn, was as suc
ful in its management, as was the engineer on
other shift who had spent practically his whole
at the business.

I presume there are instances where the plar
located in some out of the way place, where any
can get the job if they will work for the price.
such instances are in very small plants, and the
ployer who practices such methods is guilty of a
ly which he will some day come to realize. I beli
as Mr. King has stated, that it would be better to
saying so much about the modern engineer and
man and say more about their good points. Bu
change the subject I want to tell about an inci
which happened in our plant where we have a s

ɔle engine, formerly used for elevator service, ng a link motion for reversing. The engine is not l for that purpose now, but the link motion has been discarded, and thereby hangs my tale.

ne day it was discovered that the boss into which go-ahead eccentric-rod is connected, was cracked hown at *A*. The engine was required for use tically all the time, and sending for a new link nt considerable delay, therefore it was decided to ir it as best we could, so as to get the use of the ne until a new link could be secured. A strap was e as shown at *B*, the width of the link, and a hole ed through one end for the link bolt as shown at The other end of the strap was drilled for two t bolts and two holes drilled and tapped in the as shown at *D*, the bolts not quite passing through. strap was then secured in position by the bolts when the engine started up it moved along quite factorily. W. A. Leonard.

Too Much Compression.

or of the Engineers' Review:

licking in engine cylinders is very common, and it been my lot to adjust a few for different causes. ıost frequent cause is when the compression is not ıgh to overcome the back pressure. For instance, ıe case of a compound condensing engine the re- er pressure runs up above the compression. The ing sound occurs as the exhaust valves are lifted ı their seats, therefore sufficient compression is ired to overcome the back pressure of the exhaust ırder to hold the exhaust valves down on their s.

oo much compression will lift the steam valves, if ɔes above the boiler pressure. I have supervision plant having a 22 and 42x48-inch cross compound lensing engine. I have the American-Thompson oved indicator and Lippincott planimeter, which good companions for any enginer to use in case troubles as the above arise, which once located be very easily remedied.

had occasion to go to an engine plant of a paper where the exhaust was used for drying. The ex- t pipe ran along the side of the machine and ched off at different points for the dryers. At ɔpposite end of the exhaust pipe from the engine. a pipe from the steam boilers, which furnished engine with steam, also a valve to control the unt of steam required in the dryers at any time the ıust was not sufficient. Sometimes the require- ts went up to 30 or 40 pounds on some kinds of r and this live steam acted as back pressure on the ne, and then they wondered why the engine would down.

s a remedy I put in the exhaust pipe—at a point the engine, a check valve which prevented the pressure passing through the exhaust pipe into exhaust ports of the engine. We also put in a ch pipe from the engine exhaust to the atmos- e, with a back pressure valve set at 15 pounds, h is the required pressure on the machine gen- y; and if the requirements are more, and the live n valve is opened, admitting steam from the boil- nto the exhaust pipe, it can not get by the check e, which would close and the engine would exhaust the atmosphere automatically.

The compression must overcome all this back pressure and hold the exhaust valves down on their seats. I do not approve of too much compression, but it must be remembered that the adjustment of compression is a very important factor still in running engines.

Much can be said on the different conditions under which engines are run by way of sudden changes of loads, fluctuation of steam pressure, etc., all of which play a part in engineers' troubles. D. R. McL.

Use of Engine Oil.

Editor of the Engineers' Review:

I notice in the October issue, page 17, that A. F. S. wants to know about how much oil should be used in his plant. It seems to me that such a question is one that cannot be answered intelligently by anyone not connected with the plant, and it all depends upon what disposition is made of the oil after it is used.

If the engines operate anything like the engines in my plant, I should say that each cylinder on each engine would require 1 pint of cylinder oil per day, or 2 quarts of cylinder oil for the engines, and half a pint of cylinder oil for the pumps. The ideal engine would take practically no engine oil, while the Buckeye, if running in good condition, would require perhaps a quart and a half of engine oil, as would also the Gate's automatic engine. The pumps would use such a small amount that it is hardly worth mentioning at all.

The matter of oiling engines is not so much how little can be used, but how little can be used with the best results. The quality of the oil also enters into the matter and the above estimates are given with the idea that first class oil is used. I know of engines of 350-horsepower running 280 revolutions a minute, which require from 8 to 12 quarts of engine oil per day, of 10 hours run, and the bearings are hot all the time. A cheap oil is used and the engineers never feel safe in leaving the engines for a moment.

The letter Working Outiside of the Steam Plant and Obeying Orders, are, to my mind carrying the thing a little too far. For instance; Mr. Armstrong, when the superintendent ordered him to carry coal to a certain floor in the shop, instead of refusing to do it point blank, and thus bringing the matter to a head at once, deliberately shut down the plant, throwing a lot of men who were, perhaps, working by the piece, out of work and at any rate causing a loss to the company every minute the plant was idle, through the nonproduction of finished products. I believe that his place was to have refused to carry the coal, and, if matters came to the worst, refer it to the head of the company. Presidents and general managers are not in the habit of allowing matters to come to pass wherein the amount of production is curtailed, through the mistaken ideas of some subordinate official.

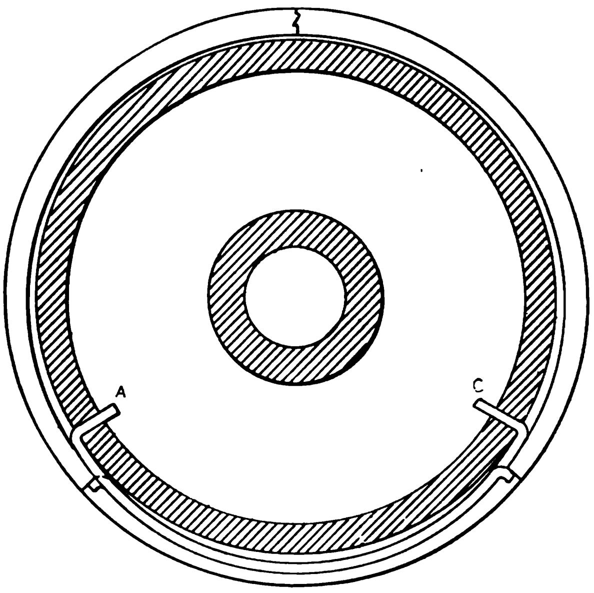
Brick Eater gives an instance where a literal interpretation of orders might have caused considerable loss of property, or even life itself. If I had orders to shut down my plant for no one but the superintendent and if, after the order became known someone rushed into the engine room yelling shut down, I would shut down regardless of the consequence. I would far rather lose my job than I would to keep it by obeying orders, and at the same time perhaps causing the life of some of the shop crew who had become caught in the machinery or belts.

Of course, in Brick Eater's case the circumstances were laughable, but they might have terminated in a tragedy had someone been caught. The sticking to orders so minutely as Brick Eater seems to have done, reminds me of the Irish servant who was told by her mistress that in the future all eggs should be laid in a cool place. Bridget replied: "Shure and I'll see thot the'r hins do it hereafther." There is such a thing as using common sense in everything, which includes obeying orders. H. J. E.

Broken Packing Ring.

Editor of the Engineers' Review:

Following is how a broken packing ring in a 15-inch horizontal engine was made to do good service.



BROKEN PACKING RING AS REPAIRED.

The engine had a single snap ring, and was leaking so badly that something just had to be done. On removing the piston, the ring was found to be broken in four pieces, one break through the thick part, and on each side of the joint. Holes were drilled through the metal at the bottom of the groove, as at *A* and *C*, and a pair of wire springs, bent as shown, were put in to push the ring up and out to the cylinder. The piston was replaced, and the engine ran *O. K.*, with a practically steam-tight piston. The two short broken pieces were left out. Duffey Price.

Will Blow at 100 Pounds.

Editor of the Engineers' Review:

I think Guy B. Cooley is mistaken in regard to his view of the safety valve problem published in the August number of the Review, when he says that both valves blow off at 100 pounds pressure. He says further, that valve No. 1, will close again as soon as the pressure in the waste pipe commences to raise and that there would be a back pressure of 100 pounds on No. 1 valve, plus the tension of the spring, which would make No. 2 blow off at 200 pounds.

Why is the back pressure in the waste pipe added to the tension of the spring? Is this additional 100 pounds on the spring alone, or on the valve? If on the valve, as he says it is, would it not relieve the spring partly of its tension, or wholly, if the pressure is the same on both sides?

If Mr. Cooley will think this over again I believe he will agree with me that No. 2 valve will blow off at 100 pounds just the same as No. 1, and that No. 1 would act simply as a bypass.

I think it is just the same as having two or more checks on a feed water line. It does not make any difference whatever to the injector or pump, excepting of course, the friction. Matt Carson.

Safety Valve Puzzle.

Editor of the Engineers' Review:

Replying to Guy B. Cooley's safety valve proposition I should say that it would require 200 pounds pressure minus the atmospheric pressure to blow off the second valve. There is resistance on the safety valve, from two sources, the atmospheric and the spring, or lever and weight, as the case may be. When the pipe connecting the two valves contains the 100 pounds pressure required to open the outer valve, there will be 100 pounds back pressure on valve No. 1, instead of atmospheric pressure, consequently there must be enough more boiler pressure to overcome the resistance of the spring or lever, which is 100 pounds minus 15 pounds (approximately) or 85 pounds. Therefore 100 + 85 = 185 or 200 — 15 = 185, more or less, as the atmosphericе pressure varies. H. C. B.

What an Engineer Should be.

Editor of the Engineers' Review:

An engineer is one skilled in the science and art of mechanical engineering. In other words, he must understand the theory of the steam engine and be able to demonstrate by practical application that the theory is feasible and correct. An engineer need not be a machinist, in fact, I think he should not, because the average engineer must take chances with an engine that a machinist thinks impossible. The machinist made the engine and he knows its strength by the rules of calculating the strength of materials. The engineer knows what it can stand by actual test at the work. The engineer will, many times, keep an engine at work, in case of trouble when the machinist would stop and cripple the service. An engineer must, at times, appear reckless and the machinist is many times too careful.

An opera had been playing all week and the company had been annoyed by two mishaps in the lighting service, one in the power house, the other in a transformer. Before the Saturday matinee, the manager of the opera house visited the engineer at the power house and was promised the very best service possible. The opera was getting in "swing" when the engine began working water. A machinist would have stopped. The engineer slowed down a little to relieve the greatest pressure, and then went on again with the least pos-

annoyance. He said he knew what the cylinder
could stand and he made it stand it. A half hour
all the babbitt came out of the upper guide and
›n the floor. The engineer was at the throttle,
ıg heard the unusual sound before the babbitt
:d. A machinist would have stopped then, but the
ıeer reasoned that the out-push would hold the
head down, and that the in-pull would also do the
thing. He kept his hand on the throttle, but let
ngine run full speed all the time. Two machin-
ave since declared that the crosshead incident was
ssible and out of the question, but nevertheless it
place as stated. J. B. Harland.

Should an Engineer be a Machinist?

›r of the Engineers' Review:

.e discussion being carried on in the Review re-
ing the question of an engineer having a machin-
experience seems to be getting warmer in each
. In entering into this discussion, I do not do
ith the idea of contradicting any statement that
ɪeen made, because each one has written his opin-
and what his experience has shown him to be
, as far as he is concerned. In answering the
ion, should an engineer be a machinist? I will say
the experience of engineers in the past shows the
er to be that it is not necessary.

e are often referred to the fact that marine en-
:rs find more favor in stationary practice than any
class, the reason being that they are supposedly
inists and therefore better fitted to assume charge.
n we look into the matter, however, this is un-
tedly not the real reason, but is due rather to the
that his experience has been more exacting, and
his practical knowledge of steam engineering has
gained after a large amount of practical expe-
e in the handling of steam engines, boilers and
iaries.

ıother reason why the marine engineer should have
›re practical experience is that he may run one
ıe one season, and have charge of another the
changing each year or two to another one which
obably of different construction. This also holds
as to the other apparatus which he must handle.
experience will bring him into contact with dif-
ıt designed engines of the compound, triple or
ruple expansion type. The latter are not often
ıntered in stationary practice.

ınditions with the stationary engineer are alto-
:r different. As a general thing he enters the en-
room through a small plant with a 14x42-inch
r and a 10 or 15-horsepower engine. He has never
:d a day in a machine shop in his life, or occupied
position that would give him any knowledge of
ıanics, or steam engineering. In many instances
scrub" engineer remains practically where he be-
that is in a small plant. It will be found upon in-
gation that the men who are in charge of our
steam plants are those who have had a good deal
:perience in handling large engines, and it is due
eir experience and knowledge of engines and boil-
ıat they are able to secure and maintain their po-
ı, and not to their knowledge of the machinist's
.

hen it comes down to a fine point there is very lit-
ork around the average steam plant that requires a thorough knowledge of the machinist's trade. It is far better to have an observing eye and to have the capacity of determining whether a certain apparatus requires repairing or not, than it is to have served time as a machinist. It doesn't take much of a man to learn how to handle a hammer, chisel and file, or to be able to babbitt a box and scrape it in a satisfactory manner. It is very seldom that we find a machine shop connected with the engine room, and if a mechanical job was required the machinist engineer, if he should be such, would be unable to do the work for lack of tools.

The engineer does not run his engine by any knowledge of the machinist's trade he may have, but depends largely upon his sense of smell and sound. The trained ear will enable him to detect instantly any unaccustomed sound, as will also the sense of smell to detect a hot bearing long before it makes its condition known otherwise.

It may be contended that an engineer in order to be able to take an engine apart and put it together again should be a machinist, but this is not so as there are hundreds of cases where the engineer who never had a machinist's training has overhauled his engine from end to end. The only advantage that I can see in an engineer being a machinist is that he may have a few little tricks in regard to the way of doing things, due to his mechanical training, that the engineer would not have, and who would go about the job in perhaps a more roundabout way.

The real advantage of an engineer being a machinist is that in case he finds himself out of employment in the one trade he could find a position in the other one, which undoubtedly would be an advantage in some instances, although I am of the opinion that a good engineer can procure a position at any time.

M. Fobbins.

Licensing Firemen.

Editor of the Engineers' Review:

In a recent issue of the Review I became most interested in an article entitled "Should Firemen be Licensed?"

I say that it would be a benefit to all concerned if they were. A great many firemen think they are O. K. just as soon as they learn how to shovel coal into a furnace. As for myself, I have had considerable experience with different firemen and have had as high as six firemen in one week. I kept on getting new men until I finally secured one who was a fireman. The first week that he was with me happened to be a light week, and I took particular pains in showing him his duties and the way in which I wanted the work done. This fireman kept his fires nice and level and the water at its proper place, besides watching his boiler feed pump to see if it was properly oiled, was careful about leaks, etc., and always kept a regular steam pressure. I had some outside duties and whenever I was called away, I always felt safe in leaving him in charge.

A man in a boiler room who does not know anything about a boiler or firing, and who takes no interest in his work; a man who runs the feed pump fast and continues to do so until the high water alarm blows, and who never pays any attention to his work, any more than to keep the wheels turning around; such a fellow is a source of danger and worry to the whole neighborhood.

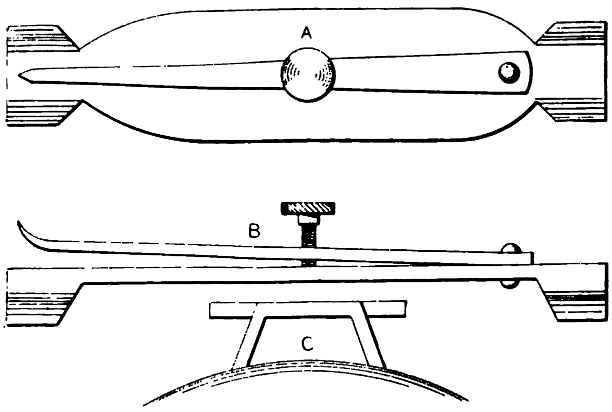
If firemen had to get a fireman's license, it would be money in the employer's pocket and a great deal better for all. M. C. R.

Piston-Rod Calipers.

Editor of the Engineers' Review:

The accompanying sketch is that of a homemade device for trueing up a piston-rod in the stuffingbox of an engine. *A,* shows the top, *B* the side, and *C,* the end as it fits on the piston-rod. It is easily made and will prove a valuable addition to an enginer's kit.

Fred Hironimus.



CALIPER FOR LINING UP A PISTON-ROD.

The Key Came Out.

Editor of the Engineers' Review:

I have been a reader of the Review for some time, but I have never yet noticed any letters from women engineers. It may surprise you, but I know of several women who look after the operation of the steam end of a plant. I have done quite a lot of work in the engine room while my husband attended to the inside work. We ran a combined flour and planing mill on a small scale for a number of years and during that time I had entire charge of the boiler and a 25-horse-power slide valve engine. I have often since thought of those days. I have had my own troubles from a practical point of view and I often wonder why no serious accident ever happened, as in those days my husband was not as good an engineer as I was.

One day the engine stopped short. I examined the valve, but it looked all right. I then removed the cylinder head and took out the follower and piston rings, etc., but everything looked fine. I was nearly wild, as there was no machinist within 10 miles. I finally got my husband to turn the engine over by hand but the eccentric never moved; it was loose on the shaft. The key had become loose and fallen out. I turned the eccentric around until the key ways were opposite each other and then hammered in the key and away went the engine the same as ever. This is only one of the many laughable simple problems we had to solve in our first years as engine runners. N. D.

Soldering Aluminum.

Editor of the Engineers' Review:

A good many engineers as well as others a
opinion that aluminum cannot be successfu
ered. There was a time when this was so, but
thing regarding soldering aluminum at the
time is not knowing how. Soldering can
with common half and half solder, if care
More than this there is a special aluminu
which of course is much better, as it make
and stronger job and is easier to use. The
are alloys which have been found to be very
ory and are cheap, easy to use, and durable:

The alloy consists of one part of alum
part of phosphor tin, 11 parts zinc and 29 p
In making the solder, melt the aluminum
then add the zinc in small pieces so as not
the aluminum which is already melted. Th
tin, taking the same precaution as with th
lastly drop in the phosphor tin. The whol
well stirred with a brass rod and poured c
molds made of open sand. The order
should be followed as given above.

When it comes to soldering, the solde
should be very heavy and untinned. It
heated to a dull redness and then rubbe
forth on the surface to be soldered, which e
air and prevents the formation of the film c
oxide. This tins the surface. In soldering
together, the parts previously tinned are
gether and heated to about 660 degrees w
dering copper, or a blow torch, until the
liquid. The two pieces are then pressec
and allowed to cool. L. M.

Just a Few Comments.

Editor of the Engineers' Review:

Some of the discussions regarding lub
the reason they will not feed is just the
my experience. I have cut my cond
off, and found that the lubricator would
steady. The trouble I have had has been
too much pipe, the water getting so cold it
the oil so that it would not feed unless it
that it all ran out in a short time. I think
found to be the trouble in a good many inst
cially where the atmosphere is cool.

Mr. Cooley, I think, is wrong in his arg
100 pounds will open No. 1 valve, it will al
2, and both will stay open until the stea
drops and allows them to close. Even if
pounds pressure left between the valves, it
steam long, for it will soon condense and
pressure.

Another letter says that there is the sam
the cylinder bolts whether the engine is
standing still. Who ever heard of a cyl
blowing out with an idle engine and how
running.

As Mr. Kennedy says, locomotive and
gineers' get lauded to the skies and some c
serve it, for we have some fine enginee
classes both as to character and mechani
majority do not compare with the stationary
reason for this is because they do not hav

:perience, and another, they do not want it. e man running now, who cannot pack his)ut gets some one to do it for him if he can. nan to run two pumps for me who had been for eight years; four years running an ı showing him around the pump, he wanted hich were the steam cylinders. I told him eight places to oil on the pump. One night 'ent to oil he could only find six. I had a ng around there and Mr. Locomotive Ened him out of bed to find where the other ɜs were. H. D.

Defends His Alarm.

he Engineers' Review:

vis in a letter contained in the August num- Review is very positive that the electric :h I described in the July number, will not ɹfactory, and that it is not reliable. He sweeping statement that all engineers know ractically impossible to keep a gland steam device operated by a float.

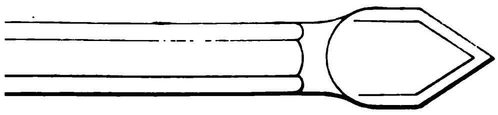
m I described, will give the best of satisroperly attended to, and the stuffingbox will if properly packed, say once a month, and avy float used.

.cipal reason for stating that the alarm is ɹeems to be because dry batteries sometimes ıd wet batteries sometimes corrode the conres, but they will very seldom do so if the properly mixed. Scotty.

A Marking Chisel.

he Engineers' Review:

er by F. Davis in a recent issue was ·sting. Among other things he advocated, f marking the eccentric so that in case it the engine shaft, it could be reset without ouble. A little device that I have used in



A CONVENIENT CHISEL.

:centrics, or in fact, marking any point on where it is required, is shown in the illusfind it almost indispensable, and it never :s.

·s know how difficult it is sometimes to eccentric and the shaft so that the lines tly opposite each other. With this little however, this difficulty is overcome. g edge should be made as shown in the not at right angles with the side. It will t the point strikes first when made as shown a true mark on the eccentric hub. By : chisel in the opposite way, a mark will be ıe engine shaft. Then in case the eccentric ıot a difficult matter to readjust it, by bringmarks together again. Chas. W. Cooper.

Indicator Card.

Editor of the Engineers' Review:

In the September issue, on page 26, R. L. Fryer presents a card for the consideration of the readers of the Review, which he calls a freak card and wants to know if any of the readers can give a cause for its peculiarity. Of course not knowing the conditions under which the cards were produced, it is impossible to give a correct answer as to the cause of the pencil marks coming as they do. However, just to hazard a guess I should say that the card had been taken with an ordinary three-way cock from both ends of the cylinder, and before removing it from the indicator drum a card was taken of the steam pressure in the steam chest, after lifting the card upon the drum of the indicator. It is doubtful if the card as shown was taken under normal conditions. In my opinion it has been doctored to bring about the result indicated.

A. H. Lane on page 27 of the same issue wonders if there would be any economy in reducing the speed of his 13 x 17-inch high speed noncondensing engine, which is running at 285 revolutions per minute, with 100 pounds boiler pressure. An engine of that size running at a speed of 100 pounds boiler pressure would easily develop 140 horsepower, which is 110 horsepower more than he uses on the average.

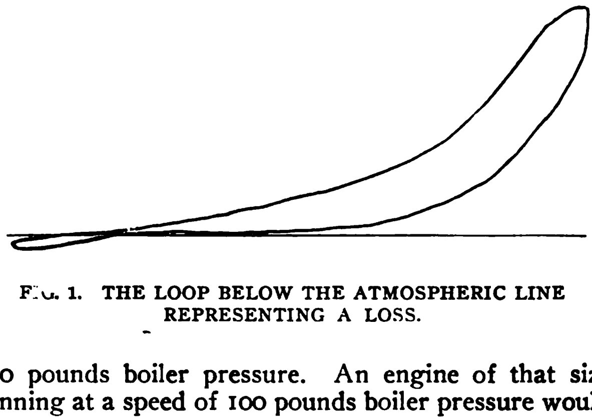


FIG. 1. THE LOOP BELOW THE ATMOSPHERIC LINE REPRESENTING A LOSS.

I am of the opinion that conditions can be so arranged that economy of fuel consumption can be made. For instance it would be of advantage to reduce the steam pressure from 100 to at least 70 pounds. I have a 13 x 15-inch engine running at 225 revolutions per minute, operating with 70 pounds of steam which easily develops from 65 to 70 horsepower, cutting off at about ¼ stroke. If he has a 30-horsepower load on the average, his 13 x 17-inch engine will surely develop all the power he requires at 285 revolutions per minute, without going to the expense of changing pulleys. If the pulley on his generator is the size that most machines of 30 horsepower would require, it is doubtful if it would be feasible to substitute a smaller pulley as trouble would be had from slipping belts.

Mr. Lane probably knows that the higher the steam pressure carried, the greater the amount of cylinder condensation, due to the difference between the cylinder walls and the temperature of the steam. If the walls of the cylinder are at a temperature of 250 degrees and the steam entering the cylinder is 328 degrees, the condensation will be greater than if the steam entered the cylinder at a pressure of 70 pounds, temperature of 202 degrees. There will undoubtedly be a saving in this respect if Mr. Lane reduces his steam pressure from 100 to 70 pounds.

Another point to consider is the work done by expansion of the steam after cutoff has occurred. With his engine operating at 100 pounds steam pressure and doing only 30 horsepower of work, the possibilities are that the steam expands down below atmospheric pressure forming the loop shown at Fig. 1. The cutoff will of necessity occur very early in the stroke, so the work done by expansion amounts to practically nothing. If he were to take an indicator card and obtain the results shown in Fig. 1, the area of the loop below the atmospheric line would be deducted from the area of the card above the line. At this point alone there is a loss if at no other.

The card in Fig. 2 is one which might be taken from the same engine running at the same speed, but at a steam pressure of 70 pounds. Here we find that although the point of cutoff is somewhat later, the area of the card is over twice as great as that shown in Fig. 1, showing conclusively that more work is being done by the expansion of the steam. I feel confident that if Mr. Lane will reduce his steam pressure, taking cards before and after that he will find that he is getting better results, and that he will also notice the difference in the firing of his boilers. High steam pressure is all right under certain conditions, but there is such a thing as getting it too high when the engine is large and the load is light.

E. H. King.

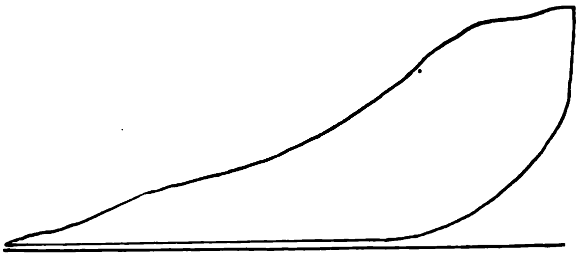


FIG. 2. MORE AS A CARD SHOULD APPEAR.

Heating Surface of Steam Boilers.

Editor of the Engineers' Review:

Question No. 447 appearing in the September issue brings up the subject of heating surface of steam boilers. One fact which is generally understood by engineers is that the amount of steam which any boiler can furnish in a given time depends upon the area of the heating surface, although the amount of steam which a square foot of heating surface will produce varies between very wide limits, and is affected by a large number of conditions.

Although a certain amount of heating surface is essential in producing a certain amount of steam, it is no more so than are the means for supplying the heat. A furnace of sufficient size and grate surface of sufficient area to burn the fuel, and a draft sufficient to supply the furnace with the necessary air, are just as essential as the proper amount of heating surface.

The furnace and the chimney are not, strictly speaking, parts of a boiler, their function being simply to supply the heat while the boiler proper is to transfer as much heat as possible to the water which it contains, therefore the capacity and economy of the steam boiler depend upon the area of its heating surface.

Boilers are to a great extent, bought and sold by their heating surface and although the price may be quoted per horsepower, the horsepower is determined directly from the heating surface. The number of square feet allowed per horsepower varies from eight to 14 according to the type of boiler. In comparing the work done by different boilers the relative heating surface is always taken into consideration.

An error is often made in computing the actual heating surface of a boiler, through taking the surface in contact with the water instead of that exposed to the fire and hot gases, as the heating surface. It should be remembered that the heating surface exposed to the fire is the actual heating surface of the boiler on which its capacity depends.

When one stops to consider the subject, he must come to the conclusion that the fire side of the boiler tube is at practically the same temperature as that of the water in the boiler and that the surface of the water side is the real heating surface of the boiler which measures its capacity for making steam. The area of the fire side of the tube is, however, what determines the heat absorbing power and the steam making capacity of the boiler. If this can be made to take up more heat in any way, the power of the boiler is increased.

When heating surface is mentioned it is usually referred to as being clean on both the fire and water side, while as a matter of fact almost invariably the fire or water side is more or less coated with soot or ash on the outside and scale on the inside. Many who are amply able to pass judgment on the matter are of the opinion that the transfer of heat is much more interfered with by deposits on the fire side than by deposits on the water side.

This brings up the old question of scale which has been threshed out so often and I have only this to say regarding the matter: I do not believe, and tests have borne out the belief, that a thin scale on boiler tubes will interfere to any noticeable degree with the capacity or economy of a boiler. On the other hand coating on the fire side of the tubes and shell does interfere in a remarkable degree with a boiler's steaming capacity and the engineer can prove this by allowing his tubes to become partly filled up with soot and then blowing them. He will see the immediate result in the manner in which the boiler steams. Without doubt a thick scale on the water side of a tube or heating surface of a shell will act as a nonconductor of heat which is liable to raise the temperature of the heating surface to such a degree as to cause a bulge or buckle.

The point to bear in mind by every engineer or fireman is that the cleaner a boiler is kept both inside and out, the greater economy will be obtained.

M. B. Greene.

Bill B. Banger's Miraculous Escape.

Editor of the Engineers' Review:

It has been written somewhere, by someone, sometime or other, that we are wonderfully and fearfully made, which is pretty nigh right, or I shouldn't be able to tell you about a little incident that happened to me a few days ago, which I came out of without a scratch, except perhaps the loss of a little hair.

The Review has been filled up more or less of late with flywheel breaks, boiler explosions and sich, but I aint seen none of um that will come up to the boiler explosion I went through the other day. A fellow by the name of Timothy Ardwheel who was engineer at the Benbow & Co. plant a little ways out of town, wanted me to come over and see what was the matter with the safety valve on top of his boiler. Well I went over, just to be sociable like, and while he was gone to the machine shop to get a wrench I got up on top of the boiler. I hadn't been there more than a minute, before I felt as if I was dropping from a balloon with a parachute, and the next thing I knew I was standing on the shore of a pond as wet as a drowned rat. Just to show that there is no joke about the matter, the following is a clipping which was taken from a local newspaper:

"AS I STOP AND THINK THINGS OVER I AM PRETTY NIGH FORCED TO THINK THAT STEAM ENGINEERING IS A TRIFLE DANGEROUS."

MIRACULOUS ESCAPE.

Of Engineer Who Rode on a Boiler That Exploded Under Him.

It will be a long time before Bill B. Banger will have another such ride as he had yesterday, or before any one else will, for that matter.

He was helping the engineer at the Benbow & Co. sawmill at Bidley Lake, in Le Sueur County, and was engaged in making some repairs yesterday forenoon when the boiler blew up. He was sitting on a box on top of the boiler, and had hold with both hands to one of the pipes at the time of the explosion.

The boiler, which is a large one, blew out endways through the side of the boiler house and curved up gracefully into the air. Banger was protected by being behind the steam dome, and so was not injured when he went through the side of the boiler house. Hanging on desperately, he continued to ride the huge projectile in its flight. Fifty feet farther on it turned sidewise, and, bottom first, struck and crashed entirely through a large warehouse. Banger coming through the wreckage still uninjured.

On the other side of the warehouse is a deep lake, and into this and to the bottom of it went Banger's iron balloon, followed by its unfortunate rider. A few seconds later Banger rose to the surface and swam ashore, somewhat surprised and dazed, but not at all harmed.

His favorite song for some time now will be "The Man Behind."—*St. Paul Pioneer Press.*

I suppose a good many fellows will say when they read this, that Bill has reached the limit and I wouldn't blame them if I couldn't refer them to the newspapers of Le Sueur County, Minn.

There is no use talking; if a fellow wants to get experience he wants to sit on top of a boiler when it blows up, and accompany it on its aerial flight through space. The sensations are something which are not to be described. The first thing you know you are there and then you aint. You are going through the air and then you are somewhere else. The newspaper didn't mention anything about the sensations, and I don't know as I can. To begin with it was hot up over the boiler and everything was quiet and peaceful as a midsummer night's dream, someone wrote about, or something of that sort. Then there was a crunching sound, the ripping of bricks and mortar, giving way of steam pipes, the hiss of steam followed by crumbling walls and falling masonry, which was all drowned by the wind as it whistled through my whiskers and remaining locks.

As the boiler sailed up into space I failed to get glimpses of the picture which must have been presented below. I was too busy hanging on to the steam pipes to bother about anything else, and when we made our turn in midair, it was a case of hang on with tooth and toe nail.

Next came the crash as we went through the store house, but that didn't stop us. Nothing short of a pond would satisfy that boiler and I went with it. I have often noticed bubbles rising in a glass of soda water, but they wern't a circumstance to the bubbles that came from that hot boiler when it struck the water. We landed with a splash that could be heard for half a mile. We went down, down, down, which was absolutely necessary for the boiler, but I could have saved a lot of strangulation if I had had sense enough to let go when I struck the water, but I didn't.

When I came up to the top after letting go my grip on the pipe, which I had been hanging to all this time, I swam ashore at a rate that would have taxed the energies of the most expert swimmer you ever saw, and I will admit that I was just a mite surprised, not to say dazed at the outcome of the whole durn business. As I stop and think things over I am pretty nigh forced to think that steam engineering is a trifle dangerous.

Bill B. Banger.

Direct Connected and Belted Dynamos.

Editor of the Engineers' Review:

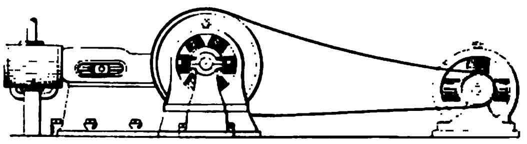
One cannot enter even the smallest steam plant at the present time, which has modern appliances, without noting the difference in the construction of plants now and those of several years ago. The extensive use of electricity for lighting and power purposes in factories, power buildings, office buildings, etc., demands something more than what the primitive method can supply. It was only a few years ago that direct driven units for private plants were few and far between and nearly all of the electric machinery of less than 10 years ago were belt driven; even in the larger stations this condition prevailed.

That there is an advantage in the direct unit over the belt connected unit is obvious to all who have given the subject any thought whatever. For small isolated plants the direct connected dynamo usually presents several advantages over the belted type. The space occupied by the engine and dynamo is greatly reduced. The noise of the belt and high speed armature is obviated while the care of the dynamo is considerably less as it does not demand as much attention, while the life of the wearing parts of the dynamo are prolonged.

About the only thing in favor of the belt driven dynamo is that it costs less, the construction is more simple as there are fewer parts, and repairs can be more cheaply and quickly made.

It is doubtful if there is any difference in the advantage of either type over the other when taken from the standpoint of efficiency where the dynamo is medium size and larger, but in machines of say under 25-kilowatt capacity the belted machine will be found slightly more efficient.

In office buildings space is of the greatest value and the room required by belt connected dynamos can always be put to profitable use, as basement room can nearly always be rented for storage, etc., and very often the rent is enough to pay a high rate of interest on the difference in first cost between the direct connected and belted unit. For this reason the direct connected unit has become generally adopted in the best type of office buildings. In large factories the direct connected unit is adopted because space in the power plant is usually limited, and the use of belted dynamos is not permissible. Usually the direct connected unit is the cheapest and best way to install the plant.



COMPARISON OF SPACE OCCUPIED BY DIRECT AND BELT CONNECTED DYNAMOS.

In electric plants of medium size which have already been built, and where space is of only a moderate value, especially in buildings where the extra room required by a belt driven dynamo would remain idle under other conditions, there is no reason for discarding the belted dynamo. The illustration shows the difference in the space taken up by direct connected unit and a belted unit which shows that the first cost of the building may be somewhat reduced as well as having the dynamo and engine compact.

L. W. Anderson.

Determining Positive and Negative Wires.

Editor of the Engineers' Review:

F. S. K. in the July Review, gives a method of determining the positive and negative wires. There is, I think, a much simpler method and one in which no mistake is possible. Take a cup, glass or basin of clear water and place the bare ends of two lead wires, taken from the line to be tested, so that they will be under the water and about 1-inch apart. The wire that produces the greatest number of bubbles is always the negative wire.

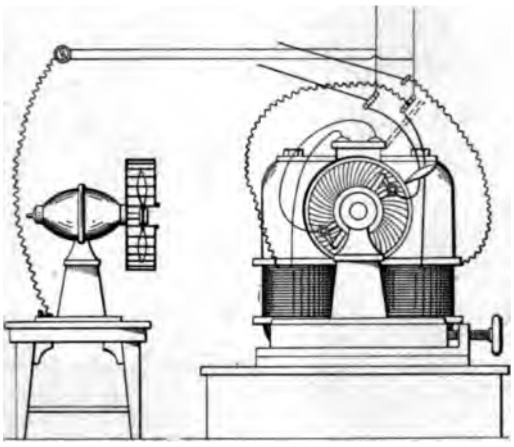
Care must be used not to bring the ends in contact or touch both ends of the vessel if it is metal; otherwise there is no danger. With a weak current, it is sometimes necessary to bring the ends almost together under the water. If the current is too weak to show then, add common salt until a strong solution is obtained. This will enable one to readily determine the positive and negative wires.

Electric.

Fan Attachment to Dynamo.

Editor of the Engineers' Review:

The illustration is a sketch of our dynamo with an electric fan attached. We have used this dynamo for some years, always receiving very good satisfaction and using any kind of brush. Recently, while turning down the commutator the tool caught the segments which were very thin from wear, and tore them all out, necessitating a new commutator. The armature was sent to the shop, refilled and returned, but we found nothing would keep the commutator from sparking and cutting, and the whole machine would become so hot as to melt the solder on the wire ends. To use copper or brass brushes was out of the question, so I applied graphite brushes and the electric fan as shown, and a nicer, smoother and cooler running machine is not built. It will run a week as well as a day with no apparent difference, but disconnect the fan for just one hour and the machine becomes so hot as to almost burn the hand when touched. The manufacturers deny any misconnections of wires and we are at a loss as to the cause. Can any of the readers enlighten me on the subject?



FAN KEPT THE DYNAMO COOL.

The fan attached is a 12-inch fan and is driven by current from the same dynamo which it in turn keeps cool, making it automatic in one sense of the word. I would advise any one having a sparking or heating machine to try the air remedy. F. W. H.

Electric Bell and Push Button Connections.

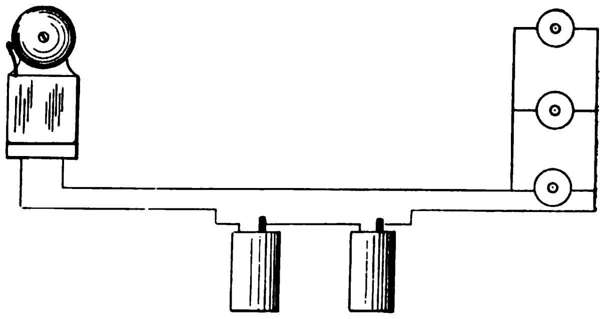
Editor of the Engineers' Review:

The following illustration shows a connection of bells and push buttons we have in our plant which is very convenient and saves the bother of having two or three different toned bells.

We have a good many small machines and belts mostly run by boys who have little, if any, knowledge of how a belt should be run off and on. The consequences are that belts are frequently wound round the shaft which, on account of the numerous piping and wires running along the ceiling, makes it extremely important that the power be shut down at once before the belt can do damage.

Formerly when a belt got wound up or it was desired to stop the power, someone had to run to the engine room with a message, which took time. Seeing the advantage of quick work in the case of emergency, I constructed a bell system having the push buttons located at various parts of the shop. The illustration shows how the push buttons were wired to the wires running to the bell.

In our case we had about a dozen batteries, but only two are shown in the illustration in order to give the idea. The same may be said of the push button. It will be seen that by using the upper push button that a circuit is made to the bell, batteries and back to the push button again. The same occurs with the second and third.



BELL CIRCUIT WITH THREE PUSH BUTTONS.

As many push buttons can be placed on a line as desired, and yet only use two wires running to the battery and bell. After this system was installed we made quick work in shutting down in case of emergency whenever the signal was given, which consisted of two bells. When ready to start up, three bells was the signal. I also had a signal system from the fireroom for the fireman to ring in case he wanted me for any particular reason. The superintendent also had a signal. This made it very convenient and saved considerable unnecessary running about. W. E. Snyder.

Cranks and Crosshead Problems.

Editor of the Engineers' Review:

In the discussion between Motor, F. Otis, and myself, I will say that they have not proved to me that the angularity of the connecting-rod is what causes the difference between the two points in the problem. In the Otis letter in the August issue of the Review, he says, "that there is a long and short quarter in the travel of a crank on a steam engine is quite evident." In this case a quarter is an angle of 90 degrees, or the one-fourth part of a circle, and there cannot be short or long quarter. In the illustration, Fig. 1, the connecting-rod in the position *L B* stands on an angle of 13 degrees. When it stands in the position

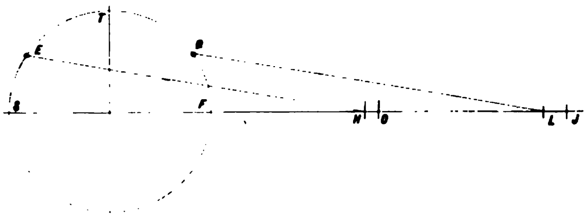


FIG. 1. SHOWING CONNECTING-RODS AT AN ANGLE OF 18 DEGREES.

H E it is also on an angle of 13 degrees, which proves that part of the problem itself, that there is no difference in the angularity of the connecting-rod, still it shows less space between *H O,* than *L J,* although the angle is the same from *T S* as from *F T.*

In another place in the Otis letters, he says, "There is no doubt but that the crank is traveling in a circle away from the crosshead for ¼ of its stroke, and towards it on the next quarter." He undoubtedly meant ½ of its stroke.

In the illustration Fig. 2, the crank travels from the dead center *F* to *T* in a circle away from the crosshead, for ½ the stroke, then the crosshead stands at *U,* a certain distance past the center of its travel, (the distance varies according to the length of the connecting-rod). From *T* to *S*, the crank is traveling in a circle toward the crosshead, but when the crank travels from *S* to *K,* it then completes that half of the crankpin circle that curves towards the crosshead. When the crank stands at *K,* the crosshead is at *U,* where it was when the crank stood at *T,* or in other words, when the crank is traveling from *S* to *K,* it is towards the crosshead until it gets to *K.* When the crank has traveled from *K* to *F,* it has completed that half of the crankpin circle that curves toward the crosshead.

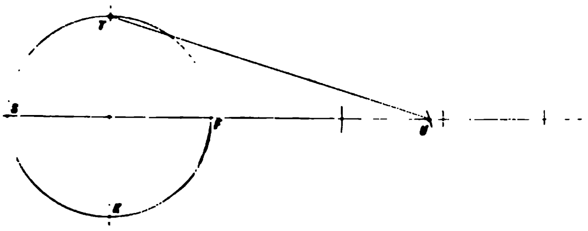


FIG. 2. SHOWING DIRECTION OF THE CRANK TRAVEL.

The crank is supposed to travel at a uniform speed, but the crosshead will be at an irregular speed and the different angles of the connecting-rod make the crosshead travel faster at a certain part of its stroke than the other. If Motor, and Mr. Otis will consider this matter I think they will see that the answer to this problem is as I have stated. A. L. J.

Homemade Reducing Valve.

Wm. Webster's apparatus for regulating the flow of water to an open heater, which was described in the April Review, reminds me of a reducing valve I made, from a discarded well pump. The plant manufactured sewer pipe and pottery, and in cold weather used a system of portable heating coils in the clay pit. As the engine did not run all of the time, live steam from the boiler was used and the pressure throttled down by a globe valve.

About every so often, through carelessness or oversight, the pressure would become too great and burst a hose or connection, doing some little damage, and causing a great deal of trouble.

Unfortunately, the "Old Man" could not see the necessity of buying a reducing valve, so I made one from an old plunger pump. Referring to the diagram, *A* is a hollow plunger working in the cylinder *C.* First nstances, however, where satisfaction has not been ı, which is without doubt due to the fact that the itions were such that the stokers should never been installed at all and had no chance of show- heir superiority over hand firing and the flat grate. is not so much the question as to whether the rs are profitable enough, but under what condi- they can be installed in order to work out suc- ully. In large plants having ash handling ma- ry installed and coal conveyors, without doubt nechanical stoker will make a paying investment, n very small plants of one or two boilers where man tends to the stoking, it is doubtful if the r has any advantage whatever. In plants rang- rom two to eight boilers the condition changes. ıe man can easily handle two and in some in- es three boilers and in the larger number of cases ɔd fireman will approach very closely to the best ice found with stokers in coal consumption. Con- to the general idea, stokers demand something than greenhorns to operate them.

would be interesting to read reports of tests made stokers and flat grates where the draft pressures the fire were below ½-inch. As far as stoker go we have no record that I know of where the pressure over the grates was less than ½-inch.

ithout doubt flat grates cannot be made to burn uch coal per square foot of grate area as can be ed on a stoker under forced conditions, but it ɔurn the same amount of coal with a lower draft ure, and can be run with a higher economy and ighter than with a stoker.

e principal reason why stokers are coming into ɔ largely, is the saving in the cost of labor, which oderate or large size plants is always possible. ability to burn fuels without the presence of volumes of black smoke is another thing in their . Probably the American firemen receive higher s than in any other country, while the price of s as low, if not lower. The loss of fuel, which is 's unavoidable to a certain extent, due to extreme ges in load conditions, can reach a rather high before equalling the saving in the cost of labor o mechanical firing. Doubtless these two items hat make the mechanical stoker so much favored. without doubt the cheapest means of abolishing e, which has become a necessity, while with hand smokeless chimneys are an impossibility.

conclusion I wish to say that there is no good ıd for condemning either the stoker or the flat , as either will give satisfaction when installed conditions warrant.

R. F. Barr.

The Steam Plant.

r of the Engineers' Review:

taking up the subject of the steam plant one that the longer it is under consideration the er ground there is for a diversion of opinions. ıature and size of the plant must of necessity be ermining factor in the selection of the engine and . It would be folly to install a water tube boiler Corliss engine in the average saw mill plant and ame holds good if it were contemplated to place ler boilers in a large lighting or power plant.

r all around work the return tubular boiler is the adapted for general manufacturing where the boiler pressure ranges from 80 to 125 pounds. In electric lighting and power plants where the steam pressure is nearer the 150 and 175 pounds mark, the return tubular boiler is not adaptable; consequently the water tube boiler will be found favorable for these pressures.

The return tubular boiler is without doubt the cheapest, as well as the easiest to keep clean and in repair. This also applies to the brick setting, while the cost of maintenance is low.

The general belief among engineers that the return tubular boiler is a dangerous boiler to operate is open to argument. In considering the question two factors must be considered, *i. e.* the way the boiler is made and the care and attention it is to receive.

Every steam boiler that has ever been made is during its life as a steam generator, an element of danger. This applies to water tube as well as to return tubular boilers, but the construction and the care given them after they are in service has considerable to do with regard to explosions.

It is true that occasionally a return tubular boiler which has been made by a reliable boiler manufacturer and which has received good care and attention from the men in charge, explodes from no apparent cause. On the other hand, the same type of boiler made by nobody knows who, and used and abused by every would-be engineer who has had a chance for the last 20 or 25 years, is still held together by some mysterious power that seems to watch over boiler and attendants alike.

In some of the so-called modern power plants, conditions are also found which ought not to exist in any plant, large or small. While looking through a large power plant recently, during the evening, it was impossible to distinguish the water level in the boilers by means of the glass. The attendants were either depending on the high and low water alarm or on the amount of water that was dripping from the try cocks. In this case the upper part of the boiler room was so poorly illuminated that the water columns and glasses were shrouded in semi-darkness. Operating boilers under such conditions should be condemned by one and all.

The water tube boiler has of recent years come into wide use and is evidently adapted to electrical work, and while its merits cannot be pointed out in any one particular, it is evident that it is an all around boiler, from the fact that it meets the requirements of the electric power station, which is about as varied as any type of power station.

In the majority of water tube boilers the shell, which rarely exceeds 42 inches in diameter, is removed from the direct heat of the furnace, and is therefore not subjected to the deterioration that the return tubular boiler is, with riveted seams which are necessarily exposed to the flames of the furnace. For this reason the necessity of reducing the boiler pressure does not affect the working value of the boiler, as it ages, to the extent that it should with the return tubular boiler.

Water tube boilers are not advocated by lazy men, as they require more attention than the return tubular boiler on account of the small amount of water in them compared to the return tubular boiler. Water tube boilers are quick to respond to any demand made upon them and when called upon to do so will develop far beyond their rated capacity. Although they are quick steamers they are equally as quick in losing their steam.

One great advantage of the water tube over the return tubular boiler is due to the fact that while 500 horsepower may be the rating of one boiler, it would require several return tubular boilers to develop the same horsepower. In the congested section of cities where space is at a premium, this is something that cannot be overlooked, as one 500-horsepower boiler will occupy less floor space than will the same horsepower in return tubular boilers.

The tendency of the times is to equip boilers of modern steam plants with automatic stokers. This applies to the return tubular boiler also, but it is a question with many as to whether they are as cheaply operated as a boiler fired by hand. It would seem that this is not so, as the greater number of the boilers in the Interborough Rapid Transit company's station which, when complete, will be the largest in the world, are to be fired by hand.

The choice of the engine should be a matter for considerable forethought. It is a noticeable fact that the majority of power plants are operated by some type of four-valve engine, and from observation it would appear that more engines of the Corliss type are used in large lighting and power plants than of all other types combined.

Outside of the matter of economy for which the Corliss is justly noted, and hence a favorite with engineers, is the accessibility of the valve gear for examination and repairs. The advantage and simplicity of the Corliss valve is so well known that it is not necessary to go into details. Suffice it to say that by removing the back bonnets, the valves may be removed from their seats through the rear opening by merely removing the four cap screws without disarranging the valve gear in the least.

Another reason why the Corliss engine is a favorite among engineers is because the valves being cylindrical are easily turned up in a lathe when they become worn, and the valve seats being cylindrical are easily rebored. There are many other advantages to the credit of the Corliss valve, such as light valves, wearing of the valves at a very slow rate, separate steam and exhaust valves and double eccentrics which allow of a later cut-off when necessity demands.

These engines are of the compound condensing type, in most large plants, but there is little choice between them and the triple or quadruple expansion engines except that the feature of simplicity is to the advantage of the compound engine.

The steam turbine is gradually gaining a place in central power stations. At this stage of its progress it is impossible to form an unbiased opinion as to its merits, when compared with the reciprocating engine. When they have out grown what may justly be termed the experimental stage and have had a chance to develop objectionable points, a better opportunity for comparison and comment will be presented.

Francis B. Houck.

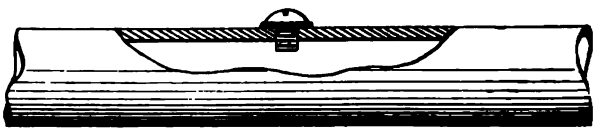
Stopping Small Leaks in Pipes.

Editor of the Engineers' Review:

Most of the engineers who write for publication I notice, deal with the larger things which occur in steam plant practice, which of course is all right; but it has occurred to me that a few of the little things might be touched upon with advantage. One of the annoying things which occur in steam plants is the pitting of steam and water pipes, which not only leads to a waste, but is a source of considerable annoyance to the man in charge.

It frequently happens that a mere pin hole comes in a pipe which may be perfectly sound otherwise. From this pin hole a spray of either water or steam escapes, which not only looks bad, but is disagreeable. It seems a shame to take out a length of pipe just because it has a little pin hole, and the engineer often does not feel safe in cutting that portion out and connecting up again because he does not know the condition of the pipe in its other parts.

A plan that I have worked to good advantage in instances of this sort, is shown in the illustration. When a pin hole occurs in a pipe line I shut off the pressure, drill a hole in the pipe where the pin hole is, and tap it out for a fine threaded screw and then screw in a round headed screw having a rubber bushing next to the head as shown. This has effectually stopped such leaks more than once, and it is the most convenient way that I know of, unless a clamp is used of which there are several kinds manufactured. Clamps are not always available, however, and in such instances the screw comes in most convenient.



REPAIR FOR PIPE UNDER LOW PRESSURE.

I think Mr. Herrin on page 12 of the July issue, gives about the best explanation as to why a three-way cock is not advisable in taking indicator cards, that I have ever seen. Such letters as that are what engineers want, rather than discussions on subjects that will never be agreed upon.

One thing I have noticed, engine builders when setting up an engine and indicating it, invariably use a three-way cock. The thing that puzzles me is this. If, by the use of the three-way cock, such discrepancies occur in valve setting as has been stated, why should these engine builders allow it to be used. The only reason that I can see is as Mr. Herrin says, it causes the diagram to show a larger area than it should, thereby giving a false impression that the engine is doing more work per pound of steam than it really is.

I am convinced that Mr. Herrin is right in his reasoning, and that for actual results cards should be taken from each end of the cylinder separately, having the connections as short as possible.

Geo. Bemis.

Closing Valves and Other Things.

Editor of the Engineers' Review:

There has been considerable written in the Review regarding the use of wrenches on valve wheels, and the evil effects of closing the valves too tight, but there has been nothing said to my knowledge against not closing the valves tight enough. I think more valves ıme leaky by not being closed tight, when they in good condition, than from all other causes bined. I have known of many engineers who : a habit of closing the valves in a haphazard and consequently are always bothered with leaky es.

ake for example a valve on a steam line being ɜd in a careless manner. It may be steam tight rst, but as soon as the valve and stem cool, they ract which allows the steam to sizzle through, especy when the pressure comes on the under side of disk as it is generally supposed to do. This steam ing through will soon cut grooves in the disk and :he seat so it will become impossible to close the e steam tight, with a wrench or otherwise.

am running a pumping station with a suction pipe o feet long, pumping from four wells. The suction slopes gradually downward from the wells toward pump for a distance of 1,900 feet and then dips n 22 feet, passing under a creek and up on the r side to the pump which is located 10 feet higher ı the wells. The lift on the suction side is some:s 24 feet. We pump against a head of 400 feet ı an 8 x 10-inch triplex power pump and a 18 x 12-inch duplex steam pump. The cost is about :nts per 1,000 gallons for fuel and labor for the er pump, but is considerably more for the steam ıp. This is a little better than in the case of Mr. y, whose letter appeared a few months ago.

would like to call H. J. A,'s attention to his example figuring the steam consumption of a compound :ex steam pump, in the July number, on page 24. nust have either made a mistake or I do not underd what he means by a duplex steam pump. He , the pump makes 25 revolutions per minute, and a 12-inch stroke and a piston speed of 100 feet per ute, for the water end. So it must have two water ıders which are double acting, and I suppose it two steam cylinders and pistons with a piston speed ıl to the water pistons, that is, 100 feet per minute. :ing off at half stroke the steam would be following pistons at full pressure for half the travel or 50 per minute. My way of figuring would be as fol: Area of steam piston 153.94-inch or 1.069 ıre feet. 1.069 × 50 × 60 = 3,207 cubic feet per r. Then weight of steam per cubic foot at 105 ıds gage pressure = .2759 pounds. Then 3,027 × 9 = 884.8113. 884.8114 ÷ 26.18 = 33.797 pounds horsepower per hour.

A. B.

Pressure on Cylinder Stud Bolts.

.or of the Engineers' Review:

ɔmeone brought up the subject recently regarding pressure in cylinders and on cylinder stud bolts. ıothing more has been said regarding the matter ve taken the liberty of writing a few things which ink will prove to the satisfaction of all that the n on cylinder studs are the same, regardless of the sure in the cylinder unless it reaches a certain sure. Supposing the nuts on the studs are screwed :ight enough to equal a pressure of 100 pounds. pressure in the cylinder of the engine may equal ounds, but the strain on the stud and nuts will be

This question seems to be disputed more or less ngineers, and will doubtless continue to be argued ss some conclusive proof is given to show that conditions are different from what they are supposed to be by some.

In Fig. 1 is shown a cylinder head having extra long studs, each one containing a stiff spring between the nut and the cylinder head. The nuts we will assume are tightened up until the springs have a pressure of 100 pounds upon them. It is evident that a pressure of 99 pounds on the inner side of the cylinder head will not force the head out against the springs, because each spring is exerting a pressure of 1 pound in excess of that which is in the cylinder. If the pressure in the cylinder is increased to 100 pounds the cylinder head will not be forced out against the spring as the pressures will exactly balance each other. If, however, the pressure in the cylinder is increased to 101 pounds, then the cylinder head will be forced against the springs, because the springs will be exerting a pressure of just 1 pound less than the pressure exerted from the inside of the cylinder. This is a

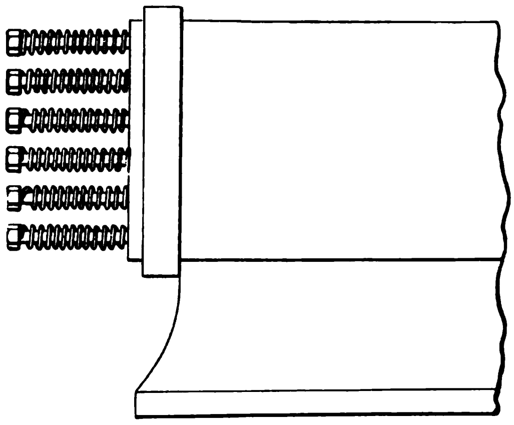


FIG. 1. SPRINGS HOLDING CYLINDER HEAD IN PLACE.

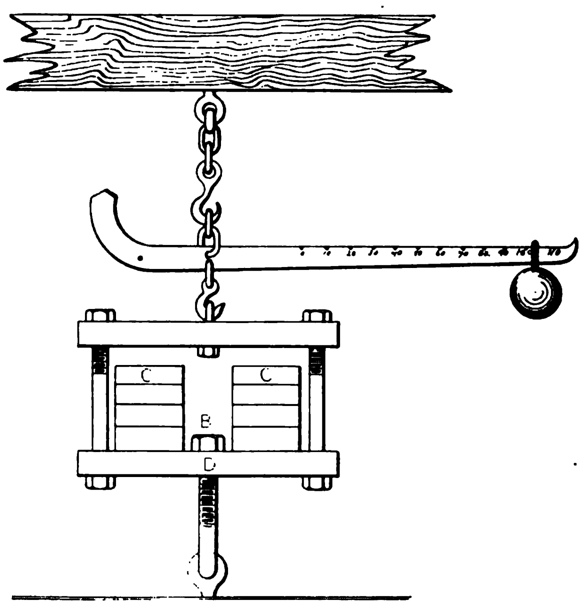


FIG. 2. ANOTHER TEST AS TO STRAIN ON STUD BOLTS.

clear explanation of how the pressure on the cylinder head is not greater when the engine is running than when it is standing unless the pressure in the cylinder exceeds that exerted against the cylinder head by the nuts on the studs.

Fig. 2 shows an experiment which may be tried by anyone having a pair of steelyards, as shown. It should be suspended from a beam capable of supporting a weight of 100 pounds or more. Make a frame as shown, having cross pieces at the top and bottom and held together by four bolts. The top cross piece has an eye bolt screwed through it which is to be hung on the steelyard hook. Through the bottom cross piece, a long threaded bolt should be inserted, having a nut and washer on the upper side. The bottom of the bolt is secured to an eye bolt in the floor, or some convenient place able to stand the strain.

When ready, place the weight on the steelyard at the 100 mark and screw up on the nut *B*, until the arm just balances. It will then be found that by adding weights as shown at *C*, which have previously been weighed that when a 101 pound weight has been placed on the bottom cross piece *D*, that the strain is taken from the nut *B*. If only 99 pounds is placed on the cross arm *D*, the strain on the nut will be exactly the same as shown by the balancing of the steelyard arm. This is another conclusive proof that the strain on the stud and nut of the cylinder head is always the same unless the pressure in the cylinder exceeds that which is exerted by the nut in the cylinder head.

Herbert Hiser.

Mechanical Draft.

Editor of the Engineers' Review:

The practice of installing mechanical draft apparatus in the modern steam plant is a question that is of more or less interest to engineers, especially to those who expect to have anything to do with it. Mechanical draft is produced by two methods, the forced and the vacuum or induced system. Under these two heads come a number of different methods of producing draft, but the principle is practically the same.

When forced draft is used, we find that the air is forced through the fire, but with the induced draft it is drawn through the fire. With forced draft the air can be supplied in two ways, first by making the ashpit practically air tight and forcing the air into it under whatever pressure will give the best result. In this way the only escape of air is through the bed of fuel on the grate and must therefore, be utilized in producing combustion. The second method is to make the fire room air tight or as much so as is possible and maintain the required air pressure in the room.

In the vacuum or induced draft system the exhaust fan is introduced between the boiler and stack and the products of combustion are drawn into the fan and exhausted in the chimney which only needs to be high enough to carry the smoke clear of the building, as the fan maintains the partial vacuum that would exist in the chimney if it were of suitable height. It is required, however, that the capacity of the fan be such as to handle all the gases produced, with the same intensity of draft as would be required in a chimney of a size sufficiently large to care for the proper combustion under the severest loads tha be carried with natural drafts.

Probably the induced draft system will fin favor with engineers than the forced draft, be seems to be the natural application of a mec draft, the effect being the same as if a chimne used. In addition to this it possesses certain f which have been found to be of great advanta chimney draft. Another thing that is in fav is the fact that when it is to be installed after has been in operation any period of time, the a ment of the setting that is required for a chimne does not need to be altered, and the intensity draft obtainable is greater and permits of a much range or regulation than other systems. A feature favorable to it is that in case the setti air leaks, the duct and ashes are drawn in rathe blown out as would be the case in the forced system.

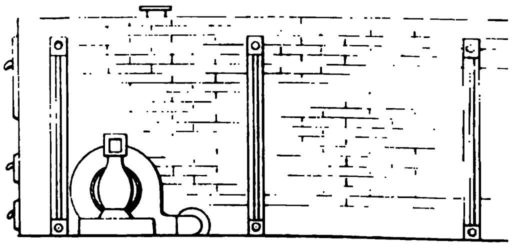


FIG. 1. FORCED DRAFT SYSTEM.

The first arrangement of mechanical draf doubtless that of the closed ashpit system and engineers still prefer it to the induced system. system may be arranged in a simple manner th applicable being that of introducing the air in sides of the ashpit through a pipe or fan. Wit simple method, however, there is a danger of b holes through the fire because the distribution air is unequal and it results not only in burning in the fire, but also tends to overheat the grate the concentration is the greatest.

One good method of distributing the air as ters the ashpit, is to introduce it through a su inlet located under the floor of the ashpit, or i bridge wall near the bottom of the pit, having a per to govern the inflow of the air which also d it downward and thus brings about a satisfactor tribution.

Although mechanical draft has given satisfacti many instances, it cannot be claimed that it has all circumstances produced greater economy, a economy of a mechanical draft depends upon c tions and the actual need which those cond present.

Cases are not at all rare, however, in which, w boiler that is well designed, the evaporative powe been increased when mechanical draft has been ployed, from 20 to 25 per cent, and in some cases tically doubled for short periods in excess of was obtained under normal conditions with chi drafts. These results are brought about by the u cheaper grades of coal which, although amounti more pounds per horsepower due to a greater i sity of the draft, the cost per horsepower will be l very often, due to the lower cost of fuel per ton. n some cases the weight of water evaporated may he same although less fuel at the same cost is l. This is due to a higher rate of combustion, but applies to cases where such is needed for the pro- combustion of the fuel.

ith the induced draft system, the fires can be ad- ed to a nicety and a more perfect combustion se- d of the gases which escape from the coal, while e same time the air supply can regulate it to bring it a proper combustion of coal on the grates. One he most important advantages of mechanical draft e perfect control of the rate of combustion, be- e the intensity of the draft is only limited by the d of the fan which may be made to cover a wide e of conditions. In plants where economizers are l and certain types of superheaters, it becomes al- t a necessity to provide some means of furnishing cient air for combustion, because of the low tem- ture of the gases reaching the chimney.

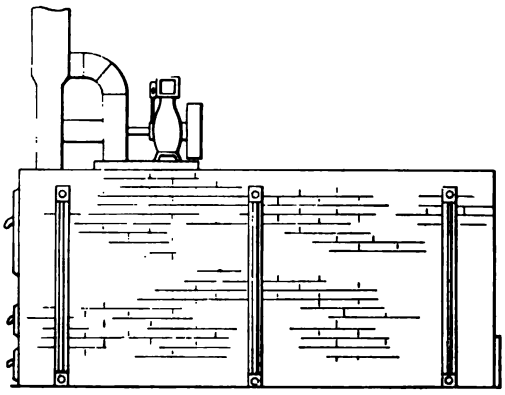


FIG. 2. INDUCED DRAFT SYSTEM.

echanical draft is also a valuable feature in plants re the demand for steam is very great only a por- of the time, which would require a larger number oilers than would be required under normal condi- s. It again comes into favor when it is impracti- e to increase the height of a chimney, and will be d in such cases, to be the cheaper method of ob- ing the additional draft required. The principal ntages claimed for mechanical draft is the ab- to control within narrow limits the rate of com- ion required for the economical combustion of any le of fuel. A closer regulation of the air required combustion is obtained which reduces the produc- of smoke, and in securing better conbustion it s to better economy. Another advantage is greater stability to changing requirements without addi- al expense for apparatus and there is also a reduc- of the first cost for producing a given draft power.

echanical drafts also permit of the installation of omizers and superheaters, without any necessity roviding other means of maintaining a draft and so permits of an absolute uniform draft regardless tmospheric conditions. It provides, too, for an omical means of increasing the draft where in- cient chimney capacity exists and permits of the of highly heated air for combustion, without in any way interfering with the disposal of the ashes, clinkers, etc.

There are many instances where the chimney is well built and proportioned, where it will prove to be in the long run as cheap a means of producing a satisfactory draft as any means that have been devised. Mechanical draft is appreciated more in instances where the chimney for various reasons has become too small to furnish the required draft or when the plant is removed to another location, or the arrangement is such that the one chimney cannot serve all the boilers to advantage. D. O. Crawford.

Fire Room Tools.

Editor of the Engineers' Review:

I notice in the Review that some of the boys of the Smutty Face tribe describe a few handy tools for the furnace and fireman. Some engineers care very little what kind of handy implements the fireman may have for himself, as they do not have to fire the furnace, and all they want is steam and plenty of it.

When an engineer does his own firing he will then take some interest in his tools and other things which will save him much hard work and extra time. I am doing my own firing and the following little kinks may come in useful to some reader of this letter.

I put chains on my furnace doors just the same as are on locomotives. First drill a hole through the door and insert an eye bolt for one end of the chain and secure the other end on the breeching or some convenient part where the chain will swing so it will be handy to catch. These chains do not look bad where they are used. I also find that a common mortar hoe with a long handle plays a good part in the handy tool game for cleaning the ashpit and grates where there are no clinkers. It is much lighter and more satisfactory to handle than the heavy iron scraper.

John L. Rucker.

[It will be found by securing one end of the chain to the handle of the furnace door and the other end to the hole in the pin or rod in the lower hinge of the flue cap doors, that the chains will hang in a very convenient position and will swing clear of every thing if they are not too long.—Editor.]

Losses in the Boiler Room.

Editor of the Engineers' Review:

The average engineer when he assumes charge of a steam plant usually forms an idea during the first week as to whether his engines are wasting steam or not. Sometimes this will be told by the amount of water consumed compared with the horsepower developed, while sometimes the sound of the exhaust will give him an inkling as to what is taking place. Be as it may, his greatest concern is that the engine is not economical. The fact that the boiler room may be where losses are taking place is usually of secondary consideration.

The more I consider the matter the more I am convinced that a large per cent of steam plant losses are due to radiation and air leakages. In fact, this is a point which has long been recognized by engineers who are at all concerned regarding the operation of their plant, and who have endeavored to reduce these losses to a minimum. Losses by air leakages are, as a general thing, passed over as a matter not to be seriously considered. Some engineers have even gone so far as to ridicule such ideas, claiming that it is drawing the point rather fine. Nevertheless the fact remains that air leakage through the boiler setting in any way is a direct loss, and a serious one, as it reduces the temperature in the flues and also reduces the draft by cooling the chamber gases.

Doubtless many air leaks are occasioned by lack of care on the part of the fireman, together with the inclination of some builders to put in an extra long furnace. It is doubtful if a furnace much over 5½ feet long can be properly fired, because of the difficulty in placing coal where it should be placed and maintaining an even thickness. With long grates it is difficult to fill the hollow places and keep the bars completely covered, the tendency being to allow the corners to become bare.

Without doubt more steam can be made by using the spreading system than any other, but to get the best results only one side should be fired at once so that the excess air to half the grates may mix hot with the air to the other half.

It may be a surprise to some to know that the majority of bituminous coals do not burn except as a gas, until about a third of their weight has been gasified. When new coal is thrown on the fire it is easily seen that the fire is chilled, due chiefly to the absorption of latent heat by the production of gas. It is evident, therefore, that thin firing is what is required if the best results are to be obtained. In burning bituminous coal much of the calorific capacity of the fuel is absorbed by latent heat from the newly distilled gas, but is rendered up again when burned later on. Bituminous coal must have time and space and temperature to burn and the higher the temperature the less time and space are required.

The question of smoke prevention has a bearing upon losses in the boiler room, for although smoke may be prevented by the admission of an excessive amount of air into the furnace, it is not an economical way of preventing smoke and often entails loss. This is because that although the air has a chilling effect, all the gases are burned before they have lost much of their temperature. It is important that all air leaks in boiler settings be prevented and that the air is allowed to enter the furnace only through the grates.

Notwithstanding the arguments advanced by a good many engineers, which would lead us to suppose that the greatest care was used in the manner in which the coal supply was handled, it is an assured fact that coal always has been and is at the present time burned by a rule of thumb method. The way in which steam engines are built at the present time allows of very little improvement to be made, as far as any immediate change in design is concerned, which will affect the economy in the reduction of steam consumption. In the boiler room, however, we surely find a place where scientific methods can be applied with advantage.

We have been told time and time again that the burning of fuel is a chemical process and can only be done properly when the chemical process is fully understood. Too many engineers and firemen think that because of this fact, it is necessary for them to thoroughly understand chemistry, but it is doubtful if this is so. A partial knowledge of the matter would, however, be found of benefit. What the engineer and fireman should be governed by is not a knowled chemistry, but its teachings. When they reco this, then they will be in a position to save coal their employer will be benefited just so much as put their knowledge and observation into pra When this is brought about we will see less agi regarding the smoke nuisance, because the form of smoke will be largely if not entirely prevente

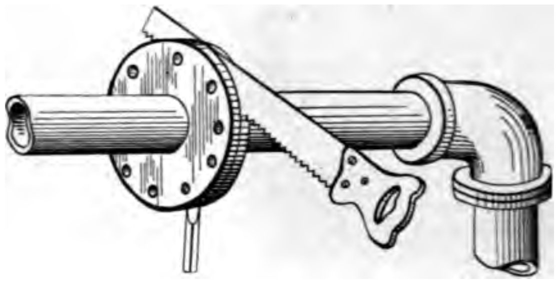
C. T. Pe

Removing Packing from a Flange Joint.

Editor of the Engineers' Review:

The job of removing old packing from flange is in many instances a comparatively easy matte pecially so when the pipe can be sprung apart en to allow for free movement of a scraper betwee two faces. There are times, however, when it i possible to force the flanges apart enough to wor tween them.

In one instance I had a pipe running from a h which was anchored solid across the room and ning down the wall as shown in the illustration.



SAWING OUT PACKING.

pipe had a flange connection which eventually b leaking. How to get the old packing out and the packing in was a problem which bothered me co erably. I finally hit upon a scheme of making of an old hand saw as shown. By driving a chisel in at the bottom between the flanges, I man to keep them from springing together and ceeded to use the saw. After sawing about half through, a chisel was driven in from the top an rest of the gaskets cleaned out, when a new one inserted, and the flange bolted together. This help someone who has had similar trouble.

I. Mulfo

Pump Repairs.

Editor of the Engineers' Review:

The following pump repairs may be of intere your readers. Fig. 1 is a case where an inner p follower was broken as shown, while getting rod out. The pump being the only means of su ing the boiler something had to be done quick washer was made from a shovel with a hammer chisel. This was pushed on the rod, then the br follower head, the piston being of the ring type piece of 2-inch pipe was put inside the inner to hold one follower against the other. This wo very well until another follower was obtained.

one instance a gland nut came off and jam- the thread so it could not be replaced. A thread- tool was made of a file by bending the end and to the thread pitch as shown, and then tempered. olding it into the thread while the nut turned, the

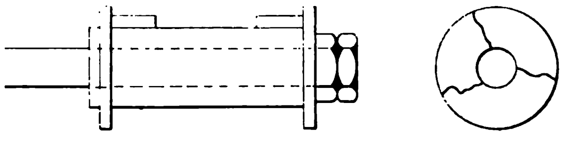
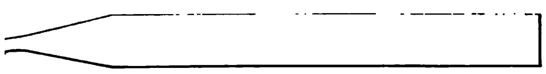


FIG. 1. BROKEN FOLLOWER.

d was cleared, and by working it in the gland d this was cleared also. Fig. 2 shows the tool.

Fig. 3 a locknut and follower on the water end pump came off and burred the end of the rod. r smoothing with a file, a nut having the same d as the rod was split and filed to give a clear- and then put in the socket wrench and turned on od, thus clearing the thread.



G. 2. TOOL FOR REMOVING BURR FROM THREADS.

e center of a valve seat which was pulled out trying to remove it, was fixed for the time being llows: After chipping it out, a wooden seat put in after boring and cutting the ports. The and spring were held down with a wood screw.

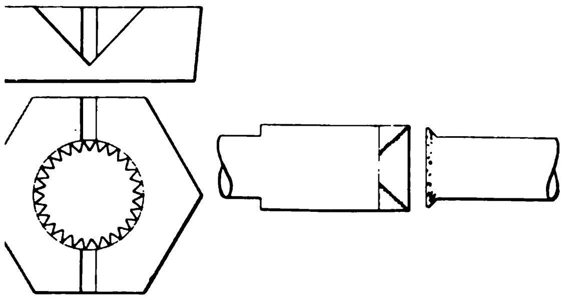


FIG. 3. TOOL FOR REMOVING BURR FROM ROD.

nall washer was put on top of the spring to fill pace so the spring could not go over the screw.

pump equipped with metal valves sometimes gave le when the lift was short. To overcome this, ce of 1-16-inch packing was placed under the s and the pump worked all right. D. F. C.

Bagged Plates and Governor Speeds.

r of the Engineers' Review:

D. S. D.'s letter regarding bagged boilers, brings mind a case where one of the plates on a boiler firing dropped down while cleaning the fire. It ed in a large goose egg shape with a small hole in the bottom which let the mud and water down on the grate. I never stopped to watch it, but got up on top and closed the valve to the header. We had a battery of 10 return tubular boilers.

There is a great deal said about firing and cleaning. I have run fires 48 hours without cleaning them, while the other fireman that worked opposite me would clean every six hours, with the same coal. Some firemen believe in throwing in a whole lot of coal at once, and then use the bar to make it burn. I have fired for a whole year and never put a bar in the fire, while the other firemen were barring half of the time. I am a good deal like the colored man about cleaning fires, I clean them when they need it. I know this: the less coal I put in the furnace the less clinkers and ashes I have to pull out.

I also see a great deal about governors sticking and that most engineers advise putting on kerosene oil to clean them. I think that if an engineer will give his governor plenty of good engine oil and clean it every day, he will not have any trouble. I am in a large flouring mill, and when we have plenty of wheat we run from Monday morning until Saturday night without a stop, but we don't have any trouble with governors sticking.

About boiler explosions. It makes no difference with a boiler, when it gets ready to leave the boiler room, whether the engineer has a license or not. Some of the worst explosions are on boilers run by licensed men. I think that there are lots of engineers who are just as good and keep their plants in better shape than a whole lot of licensed men. William C. Cline.

Painting Stacks.

Editor of the Engineers' Review:

Engineers usually solve the problem of stack painting by hiring the work done. The stack painter appears fairly regular, keeps his own counsel, does his work well, and the engineer had best let the man who has the appliances and the nerve, do the work and get paid for the risk. There may be times when it is necessary for the engineer to do stack painting, and he should at least know how to get the pulleys up.

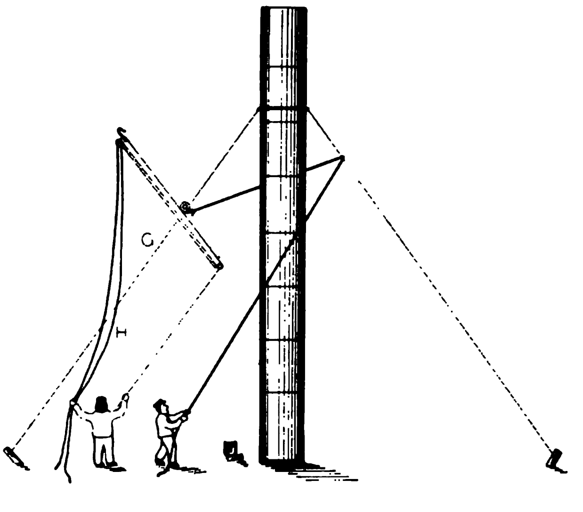


FIG. 1. PASSING THE ROPE AROUND THE GUY WIRES.

Nearly all iron stacks are secured by guy wires as in Fig. 1. There may be three or more guys, according to the stack, and the simplest way to hoist the tackle is by means of the guy wire. Measure the length of one section of the stack at the base, and standing away from the stack, count the number of sections above the guy wire, so as to judge roughly the height of the stack above the guys. At one end of a light grab pole, rig a single pulley block and a short hook, also a slip ring to the pole as in Fig 2, so that the ring will be a little farther from the hook than the height of the stack above the guys. Attach a rope to the slip ring and another to the end of the pole, as shown.

Spring the slip ring over the guy wire *G*, and have an assistant carry the free end of the rope around the stack so that the rope is over all the guys except *G*. Pull the rope and the ring and pole will slide up the guy toward the stack. When near the top of the guy, hold the rope attached to the pole at the end so that the pole stands fairly straight, and will not tangle in the other guys. Have the assistant pull the hoisting rope until the pole is against the stack. Then take the steadying rope in one hand and the two ropes *H*, from the pulley in the other, and adjust them so that the hook is over the edge of the stack. Have the assistant slack the hoisting rope, and the hook will catch over the edge of the stack. A light pole should be used, and a light hook block and ropes, as this tackle is only used to hoist the heavier blocks.

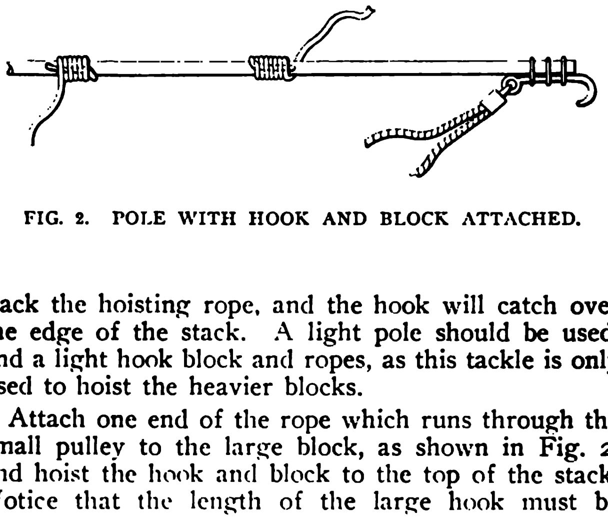


FIG. 2. POLE WITH HOOK AND BLOCK ATTACHED.

Attach one end of the rope which runs through the small pulley to the large block, as shown in Fig. 2, and hoist the hook and block to the top of the stack. Notice that the length of the large hook must be greater than the length of the small hook and block. Sometimes it is difficult to keep the large hook facing the stack. This can be done by twisting the ropes that run through the pulley attached to the hook. Make sure that the hook settles fully over the rim of the stack and that the rim is strong enough to sustain a man's weight. A seat may be fastened to the lower block, and anyone who has a cool head can pull himself to the top of the stack. Always see that the pulleys are not twisted and the blocks work free. It is best to keep the feet well apart, and touching the stack so as to avoid twisting.

When at the top of the stack loose the rope of the small pulley from the large hook, have an assistant slacken hoisting rope and the pole and pulleys will slide down the guy wire.

To take down the main tackle, stand at the foot of the stack and hold the lower pulley block, and have the assistant take the free rope of the blocks around the stack and over the guys. Twist the pulley ropes until the hook lifts off the edge of the stack, the top pulley and hook fall to the guy wires and with the aid of the assistant the tackle can be slid down the guy wires to the ground. W. A. Torrey.

Tells About His Plant.

Editor of the Engineers' Review:

Seeing that it is the fashion to tell how things are done through the Review I will tell you how we do things. My plant is a lighting plant, and as in all small towns money is rather a scarce article so that we have to make things as cheap as possible. I know how it is, as in this case I happened to be the owner as well as engineer, and in fact everything.

At first I used an injector to feed the boiler and an ejector to draw water from the well. It didn't take very long to find the bottom of my pocketbook buying coal to run those squirting machines. I think I can convince any one who claims an injector is an economical boiler feeder that they are wrong in just 30 minutes if he will get hold of my scoop shovel when the lights are all on. The injector is still on the boiler and is just the thing in an emergency and I think that every boiler should have one.

I have a belted pump for the well and an old fashioned plunger pump for boiler feeding. This I got out of a junk pile. It is speeded so as to furnish enough water for the maximum load at light head. The surplus is by-passed to a tank which is used to fill the boiler after cleaning.

A heater was also made from an old heater shell and a coil of pipes which was found in the same junk pile. This heats the water to about 208 degrees. This heater has been in use about eight years and has very little scale in the pipes.

When I repair the brick lining to the furnace and want some mortar I use wood pulp plaster which is equal to fire clay. Perhaps this sounds like using kindling wood for mortar, but if you try it you will think different.

Now about the low water alarm that some engineers want thrown on the scrap heap. I have a good one and it has never given a minute's trouble and has saved me from low water several times when I forgot to start the pump. I think a great deal of trouble with low water alarms is due to not following the instructions in connecting them up. I have seen them connected so that they would fill with mud, etc., and no way to blow them out.

My engine was not built to catch the water, oil and waste; the result was that the bed and floor were soon soaked with oil. This didn't suit so I jacked up the engine, made a tray of galvanized iron with thimbles around the foundation bolts and set the engine in it. A separator was made and the oil and water ran from the tray through it, the oil going into a pail and the water to the sewer.

I also have a homemade filter in which I use saw dust and waste as the filtering materials. If I ever make another filter of this kind I will combine the separator and filter in one. I have been using the arrangement for 7½ years and have used only 25 gallons of new oil. I have to oil, besides the engine, two generators, two countershafts and the pumps, and have sold several gallons of filtered oil to farmers. Can any of the Review readers beat this for oil? The engine bearings are flooded with oil so that I have not saved oil at the expense of the bearings.

I read considerable about the lubricator and its troubles. I have a good one, but it has remained idle since I bought a force feed oil pump which saves at least 1-3 of the cylinder oil by feeding the right amount at the right time. It starts and stops with the engine, works hot or cold and requires no attention except filling.

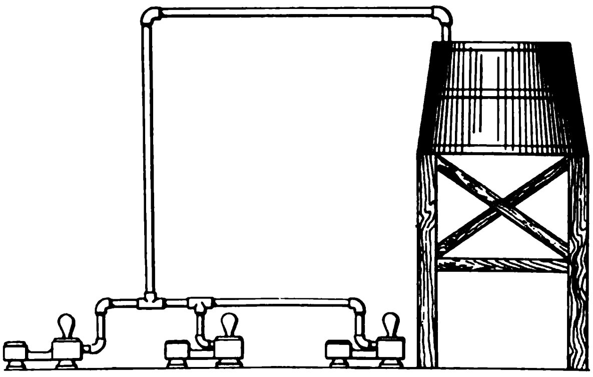
The engine room used to be pretty cold in winter as it is a wooden building. I tapped the exhaust pipe near the engine and connected several coils of pipe to it, running the drip out doors. Now there is plenty of heat without any back pressure valve or anything of the kind on the exhaust pipe.

I presume every engineer who has a piston with snap rings has been annoyed by the thumping of the head against the cylinder. The way I stop it is to remove the head from the cylinder and spring the rings out of the grooves, fill the grooves with asbestos wicking, and then put the rings back outside the wicking. This keeps the head centered in the rings and stops all thumping. It also tends to improve the economy of the engine by making an almost perfectly tight piston. I use as much wicking as possible and get the piston head in the cylinder. The wicking will stay in about a year in my case, and makes such a quiet running engine that the little work putting it in amounts to nothing. Niac.

Exhausts into a Tank.

Editor of the Engineers' Review:

About three weeks ago I was called upon to assist in piping the exhaust from three boiler feed pumps to a tank about 30 feet away and about 35 feet from the ground, for the purpose of heating the water to prevent it from freezing.



HOW THE PUMPS WERE PIPED.

My plan would be to run it through the bottom forming coils inside and allowing the exhaust to pass out at the top to the open air, but the engineer instructed me to install it in the following manner: The pumps were in line, the illustration showing the way they were connected. The tank was filled up to within a foot of the top all the time. Then the exhaust pipe was run down to within one foot of the bottom and the water was kept hot; but how much back pressure is there and what will be the result in general?

C. S. W.

Low Pressure Cylinder as a High Pressure Cylinder.

Editor of the Engineers' Review:

Last year a friend of mine who has charge of the mechanical plants in several mills, had a little experience that may prove valuable to some of your readers, who perhaps have not as yet encountered like conditions.

He was sitting in the main office about 8 o'clock a. m. reading the morning paper, when there came a hurry call over the 'phone from the Hickman mill for the chief. Hurrying over to the plant he found everything still running and he asked the assistant what the trouble seemed to be. The assistant said that everything had been doing nicely when suddenly there was a terrific bang in the high pressure cylinder that sounded very much as it would if the big double doors of the engine room had been slammed violently shut.

This was followed by a 5-pound gain in the receiver pressure and nearly a 5-inch loss in vacuum. Several cards were taken that showed serious leakage by the high pressure piston, but the run was made until noon when the mill was shut down and an examination made.

This engine was a cross compound condensing Corliss, 20 and 40 x 48-inch cylinder, nominal horsepower 750.

Cards taken a few days prior to the trouble show 814 indicated horsepower. On opening the cylinder the follower plate was found to be cracked. This was removed and the junk ring and packing ring taken out. Then the container ring, which in this make of engine is fitted onto the piston, was removed and the piston immediately fell back into the cylinder in three pieces.

The mill was rushed with orders and it was simply a question of getting new parts at once and do the best they could while waiting. The high pressure side was uncoupled and the parts ordered by wire. The engine was then jacked off the center and started with the low pressure side alone, which was connected up to the boilers with a Foster reducing valve. The spare boiler was cut in and then the load thrown on gradually until the bulk of the mill was at work.

A card taken from the low pressure cylinder showed that 766.97 horsepower was being developed. These conditions prevailed from Tuesday afternoon of one week, until Wednesday morning the week following, when the new parts having arrived they were put in place and coupled up. During this time no stop was made at noon, the engine being run very slowly to avoid stopping on the center, as there was no barring engine attached.

This is what might be termed a lucky accident, if any accident is lucky, as it broke up the piston so much, but damaged little besides that. L. L. Arnold.

The following lucid statement appears in a recent issue of the *Baltimore News:*

"To Editor Woman's Inquiry Column:

"What are the specifications of a turbine steamer?

"Ignorance."

"I suppose you mean what are the distinctive features of a turbine steamer. There is only one important difference between a turbine and a propeller. The former is a side-wheeler, the latter has the wheel in the rear of the boat."—*The Valve World.*

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BURSTING CAST IRON FITTINGS.

Several interesting facts have been brought out by experiments recently carried on at the Case School of Applied Science, as to the bursting strength of standard screwed cast iron elbows and tees. Three of each size were taken at random from a stock of pipe fittings, and the bursting pressure of the three averaged for a basis from which to determine the factor of safety. The tests were made by applying water from a high pressure steam pump, the pressure being measured by a hydrostatic gage.

The test showed that a red lead joint could not be made tight at a high pressure unless given an opportunity to become thoroughly dry, but that one of tallow was tight as soon as made up.

The test developed the fact, that elbows have a greater strength for all sizes than tees. In the majority of cases the failure of the tees occurred where the metal was a nearly flat surface. Another reason for this is because a tee has a larger inside diameter measuring through the run and outlet than an elbow of corresponding size. One elbow 2½ inches in size did not burst at a pressure of 3,500 pounds, which was the highest available with the apparatus at hand. The lowest pressure required to burst an elbow, was 1,800 pounds, which was applied to a 10-inch elbow. The lowest pressure necessary to burst a tee was 1,100 pounds, which was applied to a 4½-inch tee. As this tee was found to be defective it accounts for the low bursting pressure.

These tests serve to show that the frequent bursting of pipe fittings is due only in part to the pressure of the gases or fluids contained in them, but principally to the stresses caused by the expansion and contraction of the pipe, pipes improperly supported and water hammer, and one or all of which, in conjunction with the pressure of gas or fluid in the fitting, tends to cause a fracture.

CARELESSNESS.

Too often the press chronicles, due to a careless or foolhardy act by someone, the death or serious injury of an engineer, fireman or inspector while performing his ordinary duties. Each tragedy of this kind emphasizes the fact that one cannot be too careful in manipulating the valves around a steam plant, especially those on the main pipes to a boiler. Our attention is called to this class of casualties from a recent report that an inspector while in pursuance of his work, inspecting the interior of a boiler, was severely scalded. Steam was accidentally turned on by someone, though for what reason is not know. It is not to be thought for a moment that the persons guilty of these almost criminal acts, do so with criminal intent. It is a case of "didn't know," "didn't think," or "forgot." But no such excuse justifies the culprit, for in the steam plant the attendant should know, should think and should not forget.

Undoubtedly the larger number of accidents to men inside a boiler, or repairing pipes, etc., occur because of the reason that proper precautions have not been taken for their prevention. It is impossible in a large plant for each attendant to know what the other is doing; therefore, it is imperative, if safety is to be considered, that every measure possible be taken to prevent them while inspections, repairs, etc., are being made. As a safeguard, a very simple precaution is often used, which is effective if the attendants can read and possess even simian common sense. The inspector, engineer, or others employed about the plant, should while working in a boiler or on a disconnected steam line, hang a sign large enough to attract attention, on the valve wheel cutting off the boiler or pipe line, bearing the words, "Don't Open." An attendant seeing this would naturally make inquiries before opening it, and if he did not, the opening of such a valve would be nothing less than a criminal action and should be treated as such. Life is held too cheaply in our day and generation. The old adage, "Think twice before you act," is especially and peculiarly applicable to steam plant practice.

CYLINDER CONDENSATION.

By Charles H. Benjamin.

More than one hundred years ago James Watt said in the specification for his patent on the steam engine: "The cylinder must, during the whole time that the engine is at work, be kept as hot as the steam that enters it." With his peculiar insight into the conditions necessary for steam economy, Watt saw that the condensation of steam in the cylinder itself must be a great source of loss and bent all his energies to remedying the difficulty. In fact, he was the first one to condense the steam in a separate vessel, the early engines all having the steam condensed in the cylinder by a spray of water injected at the end of the stroke.

From that day to this engineers and designers have tried to carry out the principles first enunciated by Watt. Clothing the cylinder with noncondensing materials, enclosing it in a steam-jacket, compounding by using more than one cylinder, using separate steam and exhaust valves and finally superheating the entering steam, were all resorted to as a means of checking cylinder condensation.

This is frequently known as initial condensation because of its occurrence in a greater degree at or near the beginning of the stroke.

In the ordinary simple reciprocating engine, steam at we will say 100 pounds gage pressure or a temperature of about 340 degrees F., comes in contact with the surface of the clearances, which have just been exposed to the cool outgoing steam having a temperature of 212 degrees F. or even less, and immediately condenses.

The latent heat of the condensed steam warms up the cool surfaces and the condensation becomes less rapid, but as the piston moves on, it uncovers fresh surfaces which are cool and more steam is condensed. This process continues up to cutoff until, as shown by tests, the steam at that point frequently contains from 20 to 30 per cent of water.

During expansion some of this is usually evaporated on account of the decreasing pressure so that, at release, there may be from 10 to 20 per cent of moisture in the steam.

The remainder of the water is evaporated during the escape of the exhaust and cools the cylinder walls again.

Thus a considerable part of the steam used by the engine goes through the cylinder doing little or no work, a characteristic example of "death-bed repentance."

The use of separate valves for the steam and exhaust helps matters slightly because the live steam no longer has to pass through cold steam ports. No amount of cylinder clothing has much effect, because the condensation is occasioned by the heating and cooling of a comparatively thin layer of the cylinder wall and heads. The earlier the cutoff and the greater the expansion, the more the condensation on account of the greater range of temperature. Experiments on a simple Corliss engine have shown the least steam consumption when the cutoff ranged from one-fifth to one-fourth stroke. When the steam was cutoff earlier than one-fifth, the increased condensation more than offset the saving from increased expansion. It does not pay to use high steam pressures with simple engines for a similar reason.

The introduction of compounding, or the expansion of steam in two or more cylinders, was very effective in diminishing condensation for two reasons. It permitted high rates of expansion without excessive condensation since the hottest steam never touches the coolest cylinder. It allowed expansion in the small high pressure cylinder where the amount of surface for condensation was much less than in the simple engine of the same power.

But compounding is expensive and is only profitable where the load is nearly uniform and the engine runs continuously. Compounding has been carried as far as it is profitable to do, and engineers are now turning to superheat as a further remedy for this serious fault of the reciprocating engine. Superheating was tried many years ago and abandoned because of the practical difficulties attendant on its use, the burning of packing, the drying out of lubricants and the scoring of valves and pistons. There are troubles now for the man who uses superheated steam, but the introduction of 600 W oils, of metallic packings, poppet valves and copper gaskets will cure the most of them.

If superheat merely increased the available heat in the steam there would be little or no economy in its use, but it has been found that superheating the steam is the most effectual method of preventing initial condensation. From 5 to 10 degrees of superheat will take care of 1 per cent of moisture.

In other words, if there is 20 per cent of water in the steam at cutoff, from 100 to 200 degrees of superheat will be required to insure dry steam at that point.

This means that increasing the amount of heat put into the steam from 5 to 10 per cent will increase the work nearly 20 per cent. The advantage is apparent. Steam which has a temperature not exceeding 500 degrees F. will not occasion much trouble if proper precautions are taken.

Steam jacketing has not proved very profitable, the condensation in the jackets offsetting the saving in the cylinder.

One of the principal arguments advanced in favor of the steam turbine is that of the absence of serious condensation. As the steam is flowing continuously in one direction, hot steam cannot come in contact with cool surfaces, and the chief cause of the inefficiency of the reciprocating engine is removed.

Turbines also admit of the use of superheat with out difficulty, since there are no rubbing surfaces and no need of lubrication.

At the present time we must look to superheating and to steam turbines as the most promising means of preventing the waste from initial condensation.

QUESTIONS
·OF THE HOUR·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered. The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

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(459) J. A. R., Santa Rosa, Cal. Q.—"I am sending a diagram upon which I would like to have the horsepower and the steam consumption figured. How is the water consumption obtained?" A.—As you have not given the steam pressure or the clearance of the engine, it is impossible to do as you request. We might figure out the horsepower from an assumed mean effective pressure but it would be of no use in your particular case. If you will forward the steam pressure carried, together with the size of cylinder and the speed of the engine, we will figure the horsepower for you. As you do not give the clearance of the engine we will assume that it is not known. The position of the clearance line may be found as follows: First draw the vacuum line *A B*, Fig. 1, at a distance to represent 14.7 pounds below the atmospheric line *C D*, and then draw a straight line *E F G H*, across the compression curve. Then measuring from *E*, the distance from *G* to *H* should be equal to the distance from *E* to *F*. The line *A J*, is then drawn through *H*, perpendicular to *A B*. The distance *A K* divided by the distance *K B*, will give the percentage of clearance. To find the steam consumption of an engine from an indicator card, take some point on the compression curve as at *K*, Fig. 2, and measure its absolute pressure from the vacuum line, and compute the weight of steam at this point. This weight is subtracted from the weight of steam at the point taken in the expansion curve, already computed, and the result will be the weight of steam used per stroke. In order to make the matter clear, we will assume that the diagram Fig. 2, has a mean effective pressure of 40 pounds, engine speed 80 revolutions per minute and cylinder dimensions 20 x 36 inches. The diagram figures 166 horsepower. *L M* is the atmospheric line, and *N O*, is the line of absolute pressure drawn so that *L P*, equals 14.7 pounds to, say, a 40 scale. *N P* is the clearance which we will say equals 8 per cent of the piston displacement. The line *R K*, is drawn from the line *N O* to some point on the compression line and from *S* a point on the expansion line at a point just before release, the line *S T*, is drawn perpendicular to *N O*. Then measuring from the diagram we have *N O* = 3.24 inches; *N T* = 3.06; *N R* = .40; *S T* = .70; *K R* = .70. The length of the stroke is 36 inches and the length of the diagram is 3 inches. Then 1 inch in length of the card represents 1 foot of the stroke. The scale used is 40, and we can therefore, reduce the above dimensions to pounds pressure and to feet which give the following results: *N O* = 3.24 × 1 = 3.24 feet; *N T* = 3.06 × 1 = 3.06 feet; *N R* = .40 × 1 = .40 feet; *S T* = .70 × 40 = 28 pounds and *K R* = .70 × 40 = 28 pounds. The diameter of the piston being 20 inches, equals an area of 314 square inches, or 314 ÷ 144 = 2.18 square feet. When the piston is at the point *S*, the volume is 2.18 × 3 = 6.54 cubic feet. When the piston is at *K*, the volume is 2.18 × .40 = .8720 cubic feet. From the steam tables we find the weight of a cubic foot of steam at 36 pounds pressure, absolute, to be .088069. The weight of steam present when the piston is at *S*, is 6.54 × .088069 = .5759 pounds. The weight of steam present when the piston is at *K*, is .872 × .088069 = .0768 pounds. The weight of steam in the cylinder at the point of release is .5759, and the weight kept in at exhaust closure for compression is .0769 pounds. The weight of steam exhausted at each stroke is, therefore, .5759 — .0768 = .4991 pounds. This amount multiplied by the number of strokes per hour will give the weight of steam to be accounted for by the diagram.

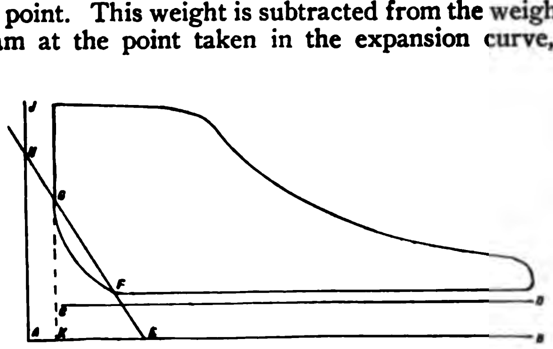


FIG. 1. METHOD OF DETERMINING CLEARANCE.

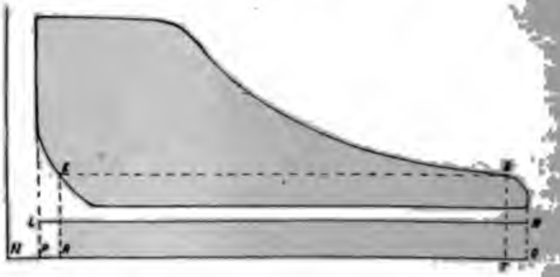


FIG. 2. METHOD OF DETERMINING STEAM CONSUMPTION.

(460) Same. Q.—"What part of 13 pounds of steam at 146 pounds gage pressure is sensible heat?" A.—The portion of heat which when applied raises the temperature of steam, and which therefore, affects the thermometer is sometimes called sensible heat. The sensible heat, or the temperature in Fahrenheit degrees of steam at 146 pounds pressure, is 131.3 degrees heat.

(461) Same. Q.—"What is the field loss in a shunt wound motor at 9 amperes and 500 volts when running free, if the field resistance is 675 ohms, and the armature resistance is 2.5 ohms?" A.—This is a simple matter of Ohm's law as the field of a direct current motor requires a definite amount of current which depends upon the resistance and the voltage. We have, therefore, the formula, $C = \frac{E}{R}$ which transposed is $C = \frac{500}{675} =$ 0.74 amphere. The armature circuits are independent of the field circuits as far as the consumption of current is concerned. The amount of current expended in the armature depends upon the difference between the counter electromotive force and the impressed voltage supplied to the motor.

ounter electromotive force is generated in the
re because the armature rotates in a magnetic
The formula for determining the current re-
in the armature is: $C = \frac{E-e}{R}$, where E
ents the volts, e the counter electromotive force
the ohms. It will be difficult however to de-
e the value of e, because such factors as the
r of the conductors upon the armature surface
g the pole faces, the density of the magnetic
the field, etc., must be known.

2) C. C. R., Cincinnati, O. Q.—"Assuming
2-3 times the theoretical quantity of air is used
n a given quantity of fuel, how many cubic feet
would be required to burn 100 pounds of coal
the following composition: Hydrogen, 6 per
carbon, 88 per cent; oxygen 3 per cent and ash
cent?" A.—The amount of air required to burn
nd of carbon is 11.6 pounds or 152 cubic feet.
termine the amount of air required to burn a
ular coal when the amount of carbon and hydro-
known: to the carbon add three times the
t of hydrogen and multiply the sum by 1.52.
esult will be the amount of air in cubic feet at a
rature of 62 degrees F. Following the above
e have 88 + (3 × 6) × 1.52 = 162.12 cubic
r 1 pound of coal. If 100 pounds of coal were
it would require 100 × 161.12 = 16,112 cubic
nd if the fuel requires 1 2-3 times the theoretical
t of air the coal would require 16,112 × 1.66 =
.92 cubic feet of air.

3) Same. Q.—"What effect has clearance on
ean effective pressure in an engine cylinder?"
he term clearance indicates the unoccupied space
en the piston and the cylinder head when the
is at the dead center. It also applies to the space
n the cylinder and the face of the valve. The
t of clearance will affect the economy of the en-
If the clearance is small the engine will be more
nical than if the clearance were large. Some of
types of engines have a clearance of from 10 to
cent of the cubic contents of the cylinder, while
engines have a clearance as low as 2 per cent.
ngine has a clearance of 15 per cent of the cubic
ts of the cylinder and is operating at a speed of
volutions per minute for 10 hours per day, it is
t that a great loss is taking place due to this
being filled twice at each revolution. The ex-
urface of the cylinder is a source of condensa-
s there is more surface for the steam to come in
t with which cools it and thus reduces its ca-
for doing work. It is evident that clearance de-
s the mean effective pressure.

4) W. W. W., Smithville, Mo. Q.—"I have a
rsepower boiler which will not hold steam over
The steam pipes from the boiler are one 2-inch
unning a distance of 20 feet; one 1¼-inch pipe
g a distance of 40 feet and one ¾-inch pipe run-
distance of 25 feet. I have no valve in the pipes
boiler. Would valves make any difference?
is no damper in the stack because the superin-
t thinks a damper would sweat the stack and
it to rust out. Would a damper help matters
I have a good fire in the morning, but have
been able to have any steam." A.—If a boiler is
it should be and there are no steam leaks from
air to the furnace, you should have no trouble in keeping up steam over night. One source of loss of steam is due to condensation in the pipes between the boiler and the valves in the pipes. As the steam condenses, more takes its place until the pipes become filled with water, which is blown out when steam is turned on the pipes in the morning. Unless the boiler is making steam faster than it condenses in the pipes the pressure will gradually decrease. The fact that there is no damper in the smoke flue of the boiler suggests another source of steam loss. If there is nothing to prevent a draft, air will certainly enter the furnace through cracks in the setting, through the crevices around the doors and the boiler will be cooled off. There is no reason why a damper should cause the stack to rust, unless the tubes are leaking, in which case they should be repaired. If valves are placed in the pipe lines near the boiler and a damper is placed in the smoke flue your trouble in not being able to keep up steam over night will doubtless disappear.

(465) L. W., Blue Earth, Minn. Q.—"Please explain the theory and operation of the pulsometer and for what it is principally used." A.—A pulsometer is a device for raising water by means of steam, partly by atmospheric pressure and partly by the direct action of the steam on the water without the intervention of a piston. It is, in fact, a type of suction pump and is used in clearing coal and other mines of water. The steam is admitted through a flexible tube into a chamber. Instead of having fixed valves, metal balls which fit snugly over apertures play loosely up and down. When the steam enters the chambers, it closes the lower aperture by forcing the ball over it, and then lifts the other ball from its seat and sends the water in the chamber through into a pipe reaching to the surface of the ground. The steam then condenses and the vacuum caused by the withdrawal of the water by the steam causes the lower ball to rise and admit a fresh supply of water into the chamber, when the same operation is repeated indefinitely. The regular "pulsing" of these balls up and down gives the pump its name. It is very effective in cases where steam piping is not possible or economical.

A NEW POLYPHASE MOTOR.

The new polyphase induction motor shown in Fig. 1, manufactured by the Commercial Electric Co., of Indianapolis, Ind., shows the result of the advantage they have acquired in obtaining the services of Mr. H. M. Hobart, of London, who has for years past been engaged in designing corresponding lines of manufacture for various continental factories. It is claimed that this induction motor is excelled by nothing on the European or American market as to ventilation and detail of operation. These machines are constructed in two different classes for constant speed work, the selection of the class depending upon the nature of the work to be performed.

The advantages possessed by these machines are many, but mention is only made of points which are of paramount importance to users of the motor. The design of the stator frame and stator head are such that an equal division between the external diameter of the rotor and the internal diameter of the stator make the clearance always the same, it being impossible to assemble their machine in such manner as to give the rotor an unequal air gap on opposite sides.

Very large bearing surfaces are provided to reduce the wear of the rotor shaft to a minimum. The bearings of the machines are self-oiling and self-aligning and are arranged so that the machine can be conveniently inverted when desirable. They are made dust proof when so ordered.

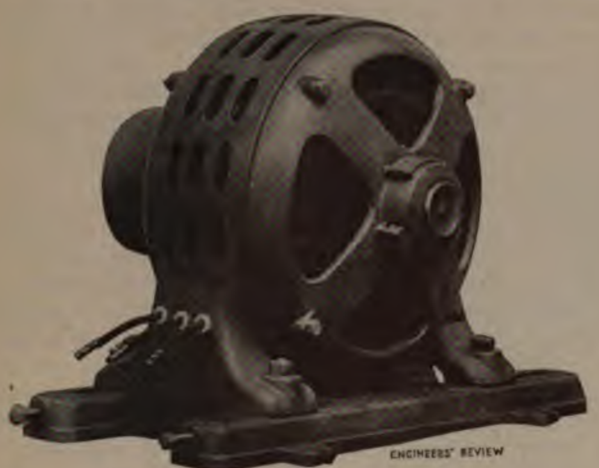


FIG. 1. MOTOR ASSEMBLED.

The shafts are made of crucible steel of large diameter, the distance between the bearings being reduced to a minimum, so that the shaft is rigid and not easily sprung. Ventilation apertures are provided across the face of the stator and rotor cores as shown in Fig. 1, so that the freest circulation of air is secured which insures cool operation.

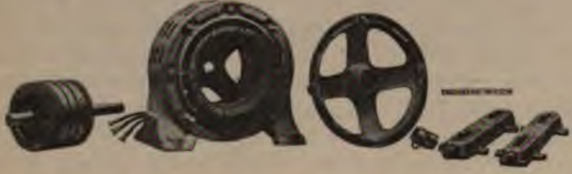


FIG. 2. SHOWING PARTS OF THE MOTOR.

Fig. 2 illustrates the parts of the motor, which shows the simplicity of the machine. The following advantages, which should be of interest to the purchasing public, are claimed; high power factor, large nominal break-down factor, high efficiency of both heavy and light loads, low working temperatures, small idle currents and high starting torques.

THE BARD ADJUSTABLE BUSHING.

The Bard adjustable bushing made by the Armstrong Mfg. Co., of Bridgeport, Conn., has some new features which will recommend it at once to all users of bushings as well as to the trade in general.

This bushing is fitted with hardened jaws which are moved to and from the center by means of a cam plate, and by fastening the plate with the thumb screw, the jaws are firmly held in any desired position.

The adjustable jaws make a perfect center for the pipe or rod, fit closely around the same and insure the cutting of a straight thread. When necessary a crooked or drunken thread can be cut with this bushing as easily as with a ring bushing.

When once attached to the die stock it can always remain there. It does away with the necessity of carrying a number of loose ring bushings, and saves the time now lost in hunting for, and changing the bushing for each size of pipe, and there is no more winding tin or paper around the pipe or rod.

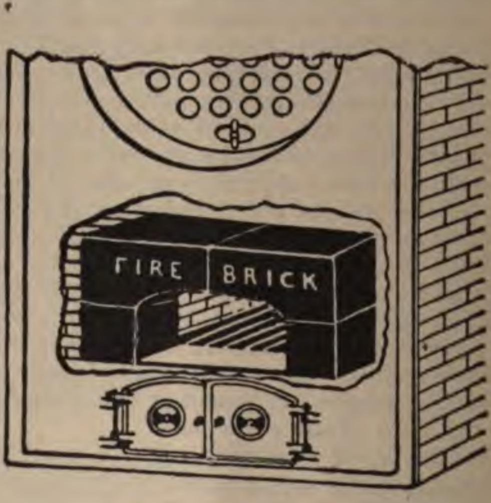
THE BARD ADJUSTABLE BUSHING.

This adjustable bushing can be furnished to fit the genuine Armstrong stocks and dies Nos. 1, 2, 2½ and 3.

PRESBREY FIRE BRICK.

When an engineer finds that the cast iron arches and side cheeks of his furnace are burned out and require replacing he is very apt to wonder why some sort of a fire brick is not manufacured which will take the place of cast iron, and thus facilitate in making rapid repairs to the furnace in this respect.

The Presbrey Fire Brick works, 208 Somerset avenue, Taunton, Mass., manufacture fire brick in any shape or size. In the illustration it is shown that the furnace arch is constructed of but four pieces of fire brick. Therefore, in case of repairs it is a simple matter to remove the old fire brick arches and substitute the new. Besides this advantage there is not the annoyance of being obliged to draw the fire in order to repair the brick work, which protects the dead plate, because the cast iron arches have burned off and allowed the fire brick to fall down, leaving the dead



PRESBREY FIRE BRICK.

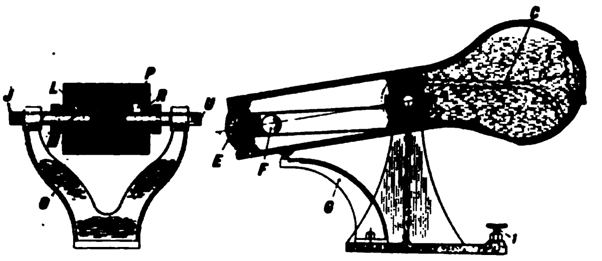
plate unprotected. With the Presbrey fire brick arch this danger is greatly obviated.

The company also furnishes fire clay, granite clay, kaolin, fire sand, etc., by the ton or cargo.

THE YOUNGSTOWN STEAM TRAP.

A poor steam trap is worse than none at all, and causes an endless amount of trouble. The manufacturers of the Youngstown steam trap seem to have constructed a trap which is durable and exceedingly simple in operation. The bowl is tested to 300 pounds steam pressure and is guaranteed to operate successfully under pressures from 1 to 250 pounds. They do not require special construction for different pressures. One of the greatest points of superiority in this trap is the changeable counter weight in the cylinder. When the trap dumps, this weight moves to the position near the axis, thereby changing the center of gravity and causing the trap to discharge a greater quantity of water. The operation of the trap is controlled by gravity.

The trap is normally in the position shown in the illustration and operates as follows: The condensation passes to the pivot pipe at *U*, Fig. 1. From thence into the receiving vessel through the ports *R* and *P*. When the receiving vessel is filled with water, the trap drops from the arm *G*, Fig. 2, on which it rests while filling, to the arm *I*, and the water is discharged from the trap through the discharge pipe *C* and *J*, shown in Figs. 1 and 2, the discharging end of the pivot pipe. While the trap is rocking from the arm *G* to the arm *I*, it moves the ball valve *L* off the port *M*, an operation which allows the water to pass from the discharge pipe *C* into the pivot pipe and to discharge at *J*, the end of the pipe.



FIGS. 1 AND 2. SECTIONAL VIEW OF YOUNGSTOWN STEAM TRAP.

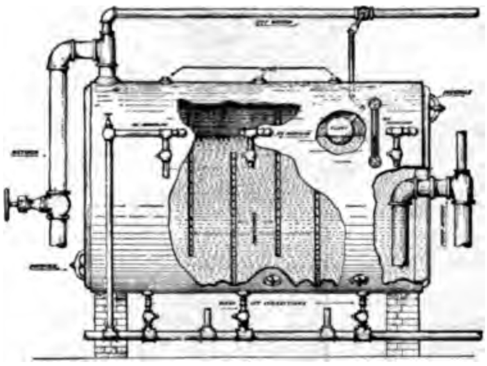
In discharging, before the trap reaches a horizontal position, the ball *F*, rolls from its position in the balance end of the trap at *E*, to the middle of the trap which gives the water end the aid of the counter weight to enable it to discharge. When the water has all been discharged from the trap, the balance end being heavier than the water end causes the trap to rock back to its original position for filling, the ball *F*, rolling back to its position at *E*, in the balance end of the trap. In case of a gush of water, the trap remains in a discharging position, thereby taking care of the sudden accumulation of water. This trap is manufactured by the Youngstown Steam Trap Co., Keystone Bank building, Pittsburgh, Pa.

RECEIVER AND OIL SEPARATOR.

The receiver and oil separator herewith illustrated is something new. It is intended to be used in connection with a heating system. The separator is not connected into the exhaust steam line, but is connected at a point where the returns or condensation returns to the basement. It operates as follows: After the steam has passed through the heating system it returns to the basement, coming back into the receiver, which has previously been filled with fresh water. As the exhaust steam has condensed back into water and the cylinder oil is back to its natural state, the oil will flow from the surface of the water through the oil overflow pipes.

The action of the water in the receiver is down under the first partition, up over the second, under the third and over the fourth, all being water tight at the seams, then down to the bottom of suction pipe, shown at the right. The float is connected to the city water line and admits water according to the amount of leakage in the system.

Should the water be shut off or the float become disabled, as soon as the water level dropped to the center of the tee in the suction pipe, the pump would get air through the top of suction, instead of water through the bottom, thus preventing it from pumping the receiver empty and all of the cylinder oil into the boilers. Should the cylinder oil become heavy with sediment it will sink to the bottom, the same as it will in a boiler. With the natural flow of water down under the first partition the oil will separate and the second partition will guide it to the surface again, and the valve will do the rest. If the oil is to be saved close the valves on the oil overflow pipes and open the plug cocks.



RECEIVER AND OIL SEPARATOR.

This receiver and oil separator can be used as a hot well in a condensing plant where the surface condenser is used.

If you are troubled with oil in your boilers or in your ice making, the McKnight receiver and oil separator will aid you to get rid of the trouble. It will handle all of the returns of condensation and the discharge from live steam traps, and the water will, it is claimed, be free from sediment when pumped back to the boilers or used for other purposes. For further information address Walted J. McKnight, 70 Riley street, Buffalo, N. Y.

THE LOEW FEED WATER HEATER CLOSED 6-PASS TYPE.

The Loew feedwater heater illustrated below, is so constructed that the water when travelling through the tubes reaches the several ports at the top and bottom of the tubes so that the course of the water is entirely changed and passes six times through the exhaust steam. The operation of the heater is as follows:

The cold water at once enters section 1, through the "water inlet" and is carried up to the double port at the top of the heater, where its course is entirely changed and the water mixed, accomplishing the first equalization of its temperature. It then passes down the tubes section 2, through a cored passage to the port at the bottom, which repeats the equalizing of the temperature, and traveling up section 3, it reaches a double port at the top, which again mixes it. Continuing down tubes section 4, it reaches another port, which repeats the mixing of the heating water and it travels in tubes, section 5, to a final double port where the temperature of the water is thoroughly equalized and then down through tubes section 6 to the outlet. The cold water is received on one side and the hot water discharged on the opposite side, but the ports are so arranged that the expansion is perfectly equalized, thus preventing any undue strain.

LOEW FEEDWATER HEATER.

This heater is built of heavy cast iron and brass, the outer shell, legs and caps being of cast iron. The tubes are of straight seamless brass. The ends of the tubes are rolled into tube plates, the bottom tube plate being bolted to the casting at the bottom of the heater, making it stationary, but the top tube plate is loose and free from the outer shell, so that the tubes have ample room to expand upward when hot.

Handhole plates are provided at the bottom that the heater may be quickly cleaned. The top heads are easily removed and the bottom unbolted and dropped down when an open surface of the tube for cleaning is desired, and the complete cleansing of the heater can be accomplished in a very short time.

The advantages claimed for this heater are, that it has an extremely large heating surface, also a long exposure of the water to the heat. It is remarkably simple in construction and great care has been taken to prevent unequal expansion or strain at any point; there is no possibility of leakage and its large heating surface has enabled the manufacturers to reduce its size to a minimum. This heater is manufactured by the Loew Supply & Mfg. Co., Cleveland, Ohio.

A RELIABLE SAFETY WATER COLUMN.

The extended use of the safety water column illustrated in Fig. 1, has proven the fact that it can at all times be positively relied upon and there is no question as to its practicability.

The column is so constructed that an alarm is automatically sounded when the water in the boiler approaches the high or low danger limit. The manufacturers claim that they have never had a complaint against the positive action of the column in this respect.

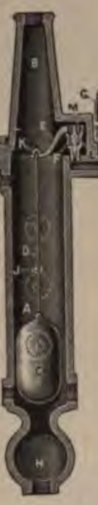


FIG. 1. SAFETY WATER COLUMN.

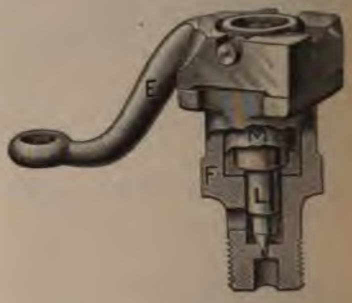


FIG. 2. CONSTRUCTION OF VALVE.

It not only safeguards the boiler and its attendants, but it is said that actual tests have demonstrated the fact that a substantial economy in fuel is effected by its use.

This is accomplished by carrying the water in the boiler at the lowest constant level consistent with absolute safety, which increases the steam space in the boiler, produces more steam, hence steadier power, and decreases the consumption of fuel.

Steady water carried at the proper level lengthens the life of a boiler, and consequently, decreases the amount of repairs necessary. The manufacturers claim that this improved safety water column will pay for itself many times over in the saving of repair bills alone.

The columns have gage cock holes tapped on both sides—consequently they can be used as either right or left hand patterns by transposing the plugs and cocks.

If repairs are necessary, the cap *B* only need be removed, when all the working parts will be exposed and are easily accessible. It is not necessary to take down the entire column, or even to remove the water gage or gage cocks.

But one strong seamless copper float is used and owing to its form and size, it never fails to operate the signal valve upon the approach of the low or high danger limit. The floats are carefully tested, and will not collapse under 350 pounds pressure.

The sediment chamber *H* is a very valuable adjunct to the column, inasmuch as it collects the dirt, scale, etc., that would otherwise enter the water gage fittings and gage cocks. A drain can be provided in the bottom of the chamber to discharge the collected sediment.

The operation of this improved safety water column is as follows: The float *C* has rigidly attached thereto the rod *D*, which operates through a hole in the valve lever *E*. The stop *J*, which can be placed in any desired position on the rod *D*, strikes the valve lever *E* should the water in the boiler become too high. Referring to the detail illustration, Fig. 2, it will be seen that as the valve lever *E* is raised it lifts the valve *L* from its seat, allowing the steam from the connection at the top of the cap, to pass through the seat opening and thence to the whistle. The same result is accomplished when the water becomes too low in the boiler. When the float falls, the knob *K*, on the rod *D*, forces the valve *E* down, which also opens the valve, allowing steam to reach the whistle.

The columns are made in various sizes suitable for the different types of boilers.

The Lunkenheimer Company, of Cincinnati, Ohio, are the sole manufacturers of this improved device to which they have given the trade name of "Vigilant."

PERSONAL.

MR. JOSEPH CAWLEY, formerly of Jas Bonar & Co., Inc., has assumed the position of vice president of the Cadwallader Tin Plate & Metal Co., Pittsburg, Pa.

CHAS. W. LAWRIE, C. E., who for several years was general superintendent of the Ball Engine Co., Erie, Pa., and consulting engineer for many of the high speed engine builders, has accepted a position as general superintendent of the Reeves Engine Co., Trenton, N. J., beginning Nov. 1.

THE CRANDALL PACKING CO. of Palmyra, N. Y., have opened a store at 9 South Water street, Cleveland, O., and members of the engineering fraternity will find one of their old friends in charge, Mr. John M. Chapman, who for many years has been in charge of the Cleveland branch of the Garlock Packing Co.

MR. J. H. MORRIS has been located in Chicago to take care of the interests of the Geo. W. Lord Co. This company have had, for many years past, a large business in Chicago, but never had a resident representative until recently. Mr. Morris has already increased the business and as he is a good fellow he will, no doubt, make a number of new friends for Lord's boiler compounds in Chicago.

NEW BOOKS.

"Transmission of Heat Through Cold-Storage Installation" by Chas. P. Paulding, M. E., D. Van Nostrand, 23 Murray and 27 Warren streets, New York, 5 x 7½, 41 pages, illustrated, cloth, price $1 net.

This volume contains formulæ, principles and data relating to installations of every kind and is a manual for refrigerating engineers. It first takes up the general principles of transmission of heat by radiation and air contact, giving tables and formulæ which are of value to the reader. These formulæ relate to radiation, conduction of heat, formulæ of homogeneous walls containing air space, floors and ceilings. The formulæ are based on facts obtained from experiments.

"Power Plant Papers," by C. E. Lucke, D. Van Nostrand Co., 23 Murray and 27 Warren streets, New, size 13 x 8, 81 pages, paper, price $1.50.

This is a book prepared for the recording of professional inspections of power plants.

The book is made up of form sheets compiled suitable for a record of data, which may be desirable to keep, of plant units, capacity and cost of plant operation, quantity and cost of supplies, sheets for boiler data, coal handling systems, draft system, boiler feed systems, engines steam distribution, piping, feedwater heating systems, economizers, condensers of different types, cooling towers, superheaters, and in fact, every head under which data can be tabulated. This should be a valuable book for those who are desirous of keeping a record of data and experiments, etc. Prof. Lucke is connected with the Columbia University, New York, and will be glad to send further information to those desiring it.

NEW CATALOGS.

Any catalog mentioned herein will, unless otherwise specified, be sent free to all who address the manufacturer requesting a copy. It will be well to mention this publication when writing.

BULLETINS NO. 1, 2, 3 and 4, issued by the Keystone Electric Co., Erie, Pa., describe fully their direct and alternating current machinery.

A GENERAL CATALOG of centrifugal pumping machinery and marine engines has been recently handed us by the Lake City Engineering Co., of Erie, Pa.

POWERS' CONCENTRATED vegetable salts boiler compound, manufactured by the Garnet Co., Allentown, Pa., is described in a little folder being mailed by this concern.

ATTENTION IS BEING CALLED to the good qualities of National iron filler cement through a small single sheet circular being sent out by the S. Obermayer Co., Cincinnati, O.

"A FEW OF THEM" forms the subject matter for a list of the satisfied users of the Williams feedwater regulator. This is being sent out by the Williams Gauge Co., of Pittsburg.

FABER BLOWOFF Valve, the Liberty oil filter and Liberty tube cleaners are described in a little circular being distributed by the Liberty Mfg. Co., 4709 Susquehanna street, Pittsburg.

"NEW DESIGNS OF STEAM ENGINES" is the title of a small catalog recently published by the Ball Engine Co. of Erie, Pa. It illustrates their new types of Corliss and high speed engines.

THE C. W. HUNT CO., 45 Broadway, New York, have recently published pamphlet No. 037 which is an introduction to the general line of conveying and hoisting machinery, which they manufacture.

THE FISHKILL LANDING MACHINE CO., Fishkill-on-the-Hudson, N. Y., have recently sent us a copy of the seventh edition of their catalog containing a description and cuts of their well known Fishkill Corliss engines.

JAS. BONAR & CO., Frick building, Pittsburg, have mailed us a single sheet circular containing a cut of their feedwater heater on one side and descriptive matter on the other. Any one interested is invited to write for catalog and prices.

THE BUCKEYE ENGINE CO., Salem, O., have sent us a leaflet containing a cut of their electric blue printing machine. They claim prices on this to be 50 per cent below all other machines of this character. A catalog will be furnished on request.

A VERY HANDSOME catalog has been recently published by the Russell Engine Co., Massillon, O. This catalog contains many attractive cuts and complete descriptions of their well known engines and describes fully their new enclosed self-oiling engine.

ANY ONE INTERESTED in automobiles and the mechanism of same will be able to learn considerable in regard to them by purchasing the new book on self propelled vehicles which is being published by Theo. Audel & Co., 63 Fifth avenue, New York. This book sells for $2.

HIGH EFFICIENCY CRANES manufactured by the Wellman-Seaver-Morgan Co., Cleveland, are fully described in a handsome catalog being sent out by this concern. It takes up fully the different types of cranes, both standard and special types for extra heavy duty.

A VERY FINE SECTIONAL catalog No. 186, printed on book paper with embossed cover, has been furnished us by the American Blower Co., Detroit, Mich. This catalog takes up and thoroughly describes their blowers, fans and dry kiln apparatus for heating, ventilating and drying.

"GRAPHITE" for November, published by the Jos. Dixon Crucible Co., Jersey City, N. J., as usual contains much of interest concerning the well known products manufactured by this firm. Any one not receiving this publication should apply to this company, who will mail each interested engineer a copy monthly.

WE HAVE RECEIVED a number of bulletins from the National Battery Co., Buffalo, N. Y., which take up several different kinds of work for which their products are being used. They invite any one who knows of a prospective installation of storage batteries to furnish them with information and full particulars.

THE PHOENIX ENGINE forms the subject matter for an interesting treatise on the development of this particular class of engine. Sectional views are shown of this engine and it also contains several cuts of indicator cards showing how a card taken from a first class engine should look. This engine is manufactured by the Phoenix Iron Works Co., Meadville, Pa.

ONE OF THE MOST COMPLETE and handsome catalogs which has come to our attention for some time has been recently sent us by the Wm. A. Harris Steam Engine Co., Providence, R. I., who manufacture high grade Corliss engines. This catalog is very complete and covers the ground of engine building most thoroughly. It contains a large list of satisfied users of their engines.

THE BERRY ENGINEERING CO., 610 Croxby street, Chester, Pa., have mailed us several bulletins concerning the specialties which they manufacture. These bulletins contain much valuable information in regard to their boiler feed control, safety water column, feedwater purifier, damper regulator and pump governor, which are some of the well known specialties which they manufacture.

A FEW REMARKS by Father Knickerbocker is the title of an attractive little booklet which is published by the Peerless Rubber Mfg. Co., 16 Warren street, New York. This little booklet takes up the history of Rainbow packing in a facetious manner. It also describes their Peerless piston and valve-rod packing and the Eclipse sectional Rainbow gasket. The Peerless Rubber Co. will be glad to send you a copy.

THE INGERSOLL-RAND CO., New York have issued catalog No. 60 which takes up the matter of stone channeling machines. This firm is publishing a series of bulletins relating to labor saving tools operated by compressed air. There have been several already issued, but these can be secured, together with additional bulletins as they are published by writing this firm and mentioning the Engineers' Review.

"WHEELER VERTICAL WATER TUBE BOILERS," manufactured by the Sharon Boiler Works, W. W. Shilling, Chestnut street, Sharon, Pa., form the subject matter for a very handsome catalog. This catalog is a work of art and the numerous half tone cuts of the Wheeler boiler and its sections make the catalog very attractive. It also contains a number of views of plants in which the Wheeler boilers have been installed.

A NEAT LITTLE BOOKLET received from the Trimont Mfg. Co., Roxbury, Mass., manufacturers of high grade wrenches, gives a report of mechanical tests which were made with the United States testing machine. Their wrenches withstood the most serious tests and thus prove to be of good workmanship and material. Any one interested in this report on wrenches can obtain more information by asking for catalog 22.

A SLIGHT DEPARTURE in the way of catalogs has been handed to us by the Struthers Wells Co., builders of the well known Warren gas engine, Warren, Pa. This catalog is known as a loose sheet catalog which instead of being bound is fastened together at the end with clips. It is well printed on a fine stock of coated paper and contains cuts and descriptions of the gas engine and various types of boilers which they manufacture. Inquiries are earnestly solicited and prompt action is assured.

THE AUSTIN SEPARATOR CO., 90 Woodbridge street, Detroit, Mich., have sent us their latest catalog, No. 15. This catalog contains a very complete exposition of the theory and principles of construction of the best types of separators. It should interest all steam users and engineers who seek greater efficiency and economy in the operation of their plants. Their
extensive line
accumulator t
tracting oil an
oil, grit and
described in t

A LARGE
has placed an
inch exhaust
THE CHA
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among engine
Good induceme
Packing Co., S

...THE...

LUBRON VALVE

makes friends wherever it is used

THERE is none better. It is a hot water valve, is noiseless, unbreakable and everlasting. It can be used with and is not affected by hot or cold water, ammonia, steam, oil or brine. **The "LUBRON" is a Pump Valve that gives universal satisfaction,** and we can prove it to you. We want to prove it to you, and will send you a free sample upon request.

We also make **Lubron** Grease and **Lubron** Self-lubricating Packings.

LUBRON MFG. CO.

Dept. S. 88 Broad St., BOSTON, MASS.

HAVE YOU EVER USED

INTERNATIONAL BOILER COMPOUND

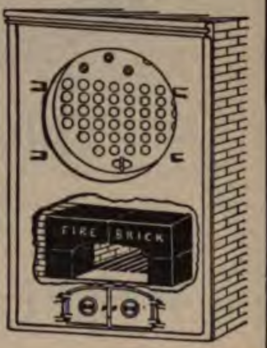
If not, you owe it to your employer to give it a trial.

We have a special offer for engineers

WRITE TODAY

INTERNATIONAL BOILER COMPOUND CO.

47 MARKET ST., CHICAGO.



FIRE BRICK

Boiler Door
Arch and
Jambs

Write for Catalogue and Prices.

PRESBREY FIRE BRICK WORKS
208 Somerset Ave.
TAUNTON, MASS.

THE USE OF THE

Reliance Safety Water Column

INSURES AMONG OTHER THINGS

Steady Water	Less Repairs
Steady Power	Less Stoppages
Steady Steam Pressure	Less Fuel

Less Expansion and ontraction

IT GIVES INSTANT ALARM WHEN THE WATER IS TOO HIGH OR TOO LOW

Write us for further information.

The Reliance Gauge Column Co.
86 E. Prospect Street CLEVELAND, O.

NUGENT'S

Catalogue of new and up-to-date Oiling Devices and Valuable Treatise on

"How to Oil an Engine"

will be sent free of charge upon request

It contains a lot of good pointers.

WM. W. NUGENT & CO.
Canal & Randolph Sts. Chicago, Ill.

Pumps and Hydraulics

IN TWO PARTS $4 By WILLIAM ROGERS

JUST PUBLISHED

Every Superintendent, Engineer, Power Pump Attendant and Machinist Should Have These Books

It is with unusual pleasure we ask your attention to our recent publication. "ROGERS' PUMPS AND HYDRAULICS" is most complete and practical, treating on the construction, operation, care and management of pumping machinery, the subject of hydraulics being thoroughly described.

This work is illustrated with cuts, diagrams and drawings of work actually constructed and now in operation; the rules and explanations of the principles shown are taken from everyday practice. No expense has been spared in our endeavor to make this a most thorough instructor on the subject. Send postal for our Pump Catalog.

THEO. AUDEL & CO., Publishers, 63 5th Ave., N.Y.

$1 DOWN

Upon receipt of one dollar, and agreement to remit the same amount each month for three months, the set will be shipped to any part of the world with all transportation charges prepaid. This method of purchasing may prove convenient and satisfactory, as it allows the use of the books while the payments are being made.

SHIPPING DIRECTIONS

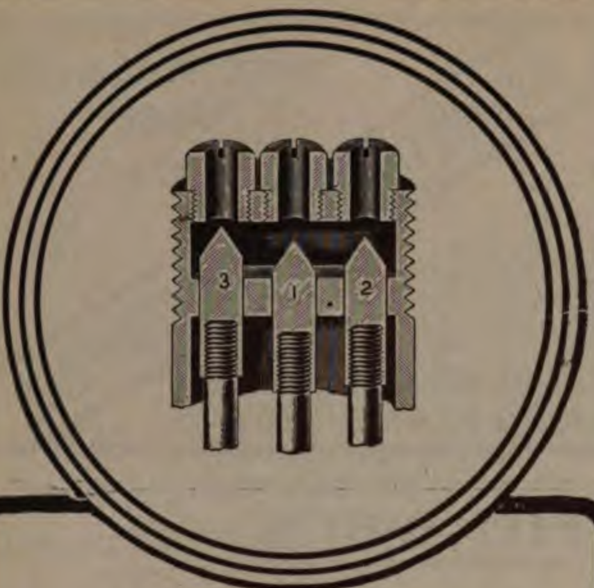
Date....................................

I enclose $1.00 (one dollar) to apply on first payment on one set of

Rogers' Pumps and Hydraulics $4
(COMPLETE IN 2 PARTS)

which ship at once to the following address, all charges prepaid. I hereby agree to remit by mail at the rate of one dollar each month, the remaining three dollars.

Signature ....
Occupation....................................
Where Employed....................................
Residence ....
City.................................... E.R.

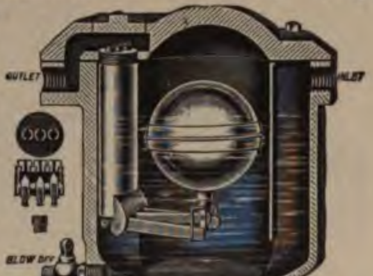


The "Valve-Rightness" of a Wright Steam Trap

Admittedly, the most important part of a steam trap is the valve arrangement.

If that goes wrong the entire trap goes wrong.

In the construction of our "Emergency" Trap we make sure of the valves above everything else before a trap leaves our factory.



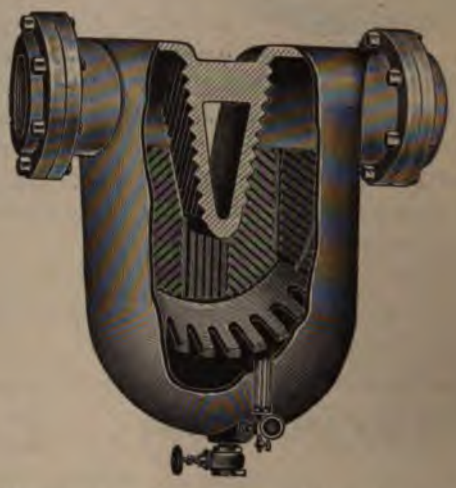
They must test perfectly. The first valve must take care of large amounts of water, under different pressures. After that we put the trap to an emergency test, subjecting it to excessive amounts of water. The second valve, and then the third, are brought into operation, and only when a trap undergoes this test without wasting a particle of steam, do we pronounce it ready for sale on our guarantee.

There is a good deal to interest engineers in our catalogue. Your name on a postal will get you a copy.

Wright Manufacturing Co.,

82 Woodbridge St., Detroit, Mich., U. S. A.

How Can Water or Oil Possibly Get Through this Separat with the Steam?



AUSTIN FIGURE "B" HORIZONTAL PATTERN.

The steam may pass through it in either directi the result will be the same.

Absolutely perfect separation of water from steam, or of oil and impurities from exhaust.

Looking at the design of this Separator will s you that it will do good work.

But there is a reason under the surface for efficient operation—

The baffle plates are set at an angle that ca the steam to rebound at an opposite angle. This up a centifrugal action that impinges all water or im ities against the corrugated sides, whence they drained down into the receiving chamber and then through the drain pipe.

Perfect separation is a matter of certainty— guesswork—and we let you prove it before buy Ask for Catalogue 15, just issued, detailing all style Austin Separators.

Austin Separator Co.

90 Woodbridge Street,

Detroit, Mich., U. S. A.

The Standard Steam Trap of America

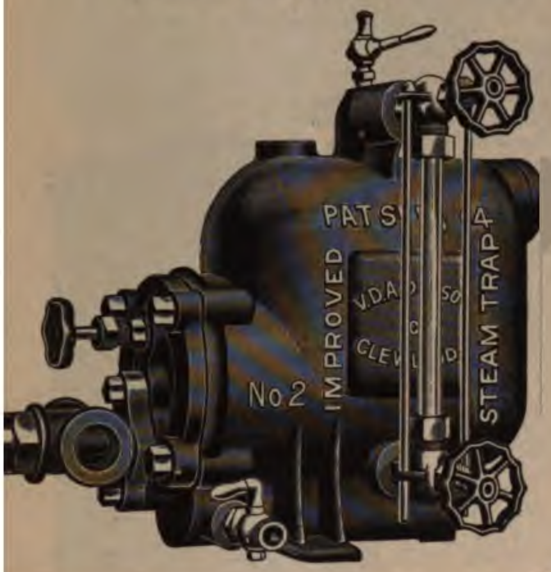
IS THE

NDERSON

MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.



Belt in Marion Stove Company, Marion, Ind. Gandy 12" belt, 11' centers, from 72" to 42" pulleys. 200 r. p. m. 17" slack. Cling-Surface used two years.

Cling-Surface and a Gandy Belt

CLING-SURFACE is just as good for Gandy, Leviathan and other painted or unpainted cotton belts, as for leather belts.

It penetrates into them, keeps them pliable, preserved, prevents any cracking, stops all slip, so that they can all be run easy or slack, carry full loads and give perfect service.

Order Cling-Surface on trial. Results guaranteed.

CLING-SURFACE CO
154-160 VIRGINIA ST BUFFALO N Y

eam Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.

Albany, N. Y., U. S. A.

Established 1871.
Fred'k Townsend, Pres.
Jas. H. Blessing, Gen. Mgr.

Send for circular describing premiums given to agents.

Engineers' Review,
Cleveland, O.

The simplest and most efficient trap on the market today is the Golden Tilting Steam Trap

It is positive, perfect in action

It has no no floats, valves or buckets to get out of order

All working parts are on the outside. If you need a new trap investigate the Golden.

Worth Has Won

THE ANDERSON CUSHIONED NON-RETURN VALVE

Is a safeguard where high steam pressure is used. It will automatically cut off the steam in case of accident to the boiler; also acts as a safety stop to prevent steam from being turned into a cold boiler

Absolutely no posssibility of chattering or hammering

Every up-to-date engineer should be familiar with this valve and other Anderson valves. They are described in our catalog.

SEND FOR DESCRIPTION OF OUR OTHER SPECIALTIES

Golden-Anderson Valve Specialty Co. 200 Pike St., Pittsburg, Pa.

VACUUM OILS

Are known and used in every corner of the world where machinery runs. They are the standards of value throughout the whole world; they lubricate every kind of machinery; not the same oil for all machines, but the right oil for each class.

They are made to fit every condition and are used everywhere because they are the best.

Once used VACUUM OILS are always used.

These oils are made at Rochester and Olean, N. Y., and are distributed throughout the world from local branches.

Abroad they are distributed from ***one hundred and twelve foreign warehouses*** and at home they are sold in every city.

VACUUM OILS

reduce friction to the limit, thus saving power. They are always uniform; can always be depended upon. They do their work better than other oils and cost less when the amount of work done is considered.

VACUUM OIL COMPANY

ROCHESTER, N. Y.

TRY IT

That is what we want you to do

We Know that

Ruggles Perfection Flue Cleaner is the simplest and most efficient on the market. We know that if you use it once you will always use it. So we say

—Try It

To enable you to do this we will send it to any responsible party for a free 30 days' trial.

WRITE TODAY

Ruggles & Ruggles
BATAVIA, ILL.

Weinland Tube Cleaner

You know as well as we do that scale in the boiler tubes puts exclamation points on the coal bills. Perhaps you don't know as well as we do how easy and cheap it is to get out any quantity of any kind of scale with the Weinland Tube Cleaner.

We've spent 20 years studying conditions, perfecting Turbine and Power Cleaners. Our knowledge and experience are at your service.

We often make special cleaners for special cases.

A postal from you will bring our printed matter; a special representative if you wish, or a cleaner on approval.

Ask us also about **The Lagonda Damper Regulator, Tube Cutter** and **Reseating Machine.** All money savers.

The Lagonda Mfg. Co.

Philadelphia
Chicago
London, Eng.

Springfield, Ohio.

New York
Pittsburg
St. Louis

Genuine Armstrong

STOCKS AND DIES

For Threading Pipe.

Universally acknowledged to be the best on the market.

The Armstrong Mfg. Co.

BRIDGEPORT, CONN.

New York Office, 139 Centre Street.

Send for Catalogue.

Repairs for Pipe Leaks---Climax Steam Joint Clamps

Made of BRASS for all SIZES of Pipe

Thousands in use. For Sale Everywhere

A PERMANENT REPAIR FOR PIPE JOINTS

MODEL FLANGE CLAMP.

This Should Interest You.

Made for All Sizes of Flanges.

To Stop Leaks Between Flanges

EMERGENCY PIPE CLAMP.

Send for our 1905 Catalog, Showing Our Line of Money-Savers.

To Repair Splits and Rust Holes on Pipes,

JAMES McCREA & CO., Mfrs., 70 W. Washington St., Chicago.

There is only ONE ALBANY GREASE

Reg. U. S. Pat. of

This Trade Mark on every package.

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Cost of using Oils
Cost of using ALBANY GREASE

Use only the best lubricants on your Engines and Machinery, It will reduce friction, save wear and tear, reduces fuel bills and machine bills and results in Great Saving.

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

ADAM COOK'S SONS,
313 West St., NEW YORK CITY, U. S. A.

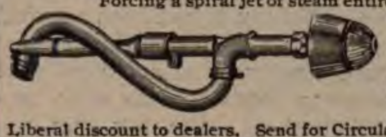
"Lightning Tube Cleaner" Features

1—Cleans scaled tubes inside or outside.
2—Propelled by water, air or steam.
3—Does the work quick.
4—Saves $2.00 every 10 hours run metered water bill.
5—Motor Wheel utilizes a compound power.
6—Construction overcomes cone and ball breakage.
7—Has re-sharpening, non-breakable cleaner head.
8—Future repairs, very small item.
9—Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

Sold on approval. Attractive proposition to State Agents.

MAURER, LABADIE & CO.
215 St. Joe Street, South Bend, Ind.

Cleveland Flue-Cleaner Manufacturing Co.
Forcing a spiral jet of steam entire length of tube.

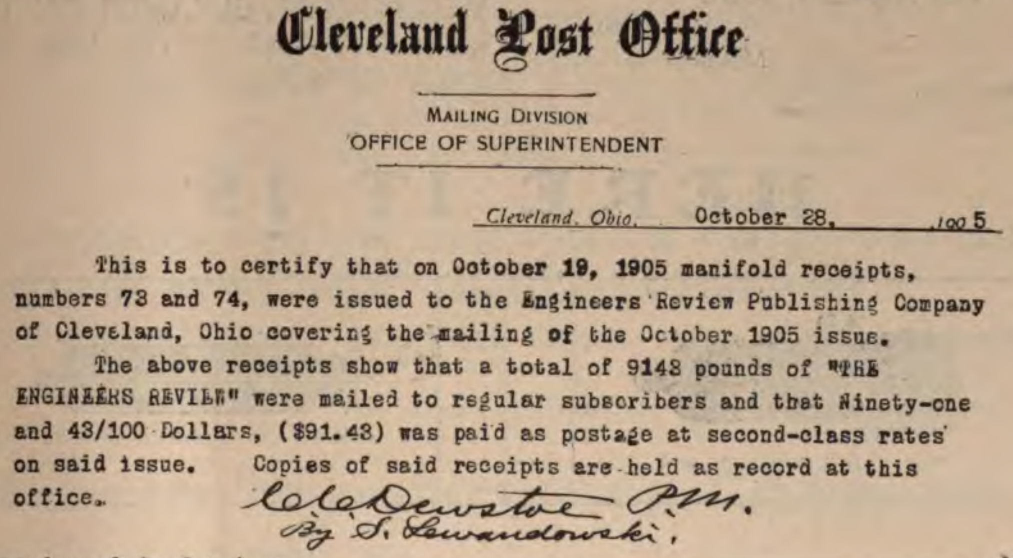


Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.
The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.
Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO,

CENTURY
The Original White Packing.
FOR SALE BY LEADING SUPPLY HOUSES.

The Doubter Discovers the Truth

and in that way benefits all to whom the "truth" is of interest. It is to satisfy the doubter, and even those who do not doubt, that the Engineers' Review gives every month absolute proof of its circulation. See explanation below.



Cleveland Post Office

MAILING DIVISION
OFFICE OF SUPERINTENDENT

Cleveland, Ohio, October 28, 1905

This is to certify that on October 19, 1905 manifold receipts, numbers 73 and 74, were issued to the Engineers Review Publishing Company of Cleveland, Ohio covering the mailing of the October 1905 issue.

The above receipts show that a total of 9143 pounds of "THE ENGINEERS REVIEW" were mailed to regular subscribers and that Ninety-one and 43/100 Dollars, ($91.43) was paid as postage at second-class rates on said issue. Copies of said receipts are held as record at this office.

C. C. Dewstoe P.M.
By S. Lewandowski,

Total number of pounds for Oct. issue	9,143 pounds
Deducting wrapping paper	150 "
	8,993 pounds
One copy of Oct. issue weighs 7.05 ounces, making a total number, mailed at the pound rate, of	20,409 copies
Copies mailed in Cleveland under stamps 191 and 300 delivered to our office make an addition of	491 copies
The total edition for Oct. being	20,900 copies

The Dean Boiler Tube Cleaner versus Compounds
Removes Scale by the Barrow Loads

Took Out 80 Wheel Barrow Loads

In the September issue of the Engineer's Review in the Idea Exchange department, page 17, there appeared a letter signed "A. R." in which the writer mentioned an experience he had with boiler scale. He said that upon taking charge of four return tubular boilers he found, upon examination, that the space between the tubes, for a distance of 9 feet from the rear head, "was filled as solid with scale as though it had been run full of Babbit metal." He persuaded the superintendent to get a mechanical tube cleaner on thirty days' trial and took out *80 wheelbarrow loads of scale*, each barrow holding about 2½ bushels. We felt that the DEAN was the only cleaner in the market that could do this and we opened correspondence with "A. R." with the following result:

Moundsville, W. Va., 10-5-05.

The Wm. B. Pierce Co.,
Buffalo, N. Y.

Gentlemen:—Yours of recent date addressed to me at Wise, W. Va., has been received and beg to state that your guess was correct in regard to the Tube Cleaner referred to in my letter to "The Engineer's Review" in the September issue. Would say that this work was accomplished for the Wheeling and Lake Erie Coal Mining Co., at Dillonvale, Ohio, at their "Dillon No. 2" Mine.

Very respectfully yours,
A. Ransom,
Moundsville, W. Va.
819 Jefferson Ave.

Used Compound and Thought Boiler Clean

In the October issue of the Engineer's Review, page 18, appeared another letter which we reproduce:

Tube Cleaner Caused a Surprise.

Editor of the Engineers' Review:

We had this experience in our plant recently: We have two S. F. Freeman boilers, marine type, of 200 horsepower each. We have been using compound right along and thought our boilers comparatively free from scale. The other day the manager purchased a hammer tube cleaner, and on using it the results were surprising. We took from both boilers at least 1,000 pounds of scale, in two days.

The cleaner has not injured the tubes in any way, shape or form, as far as we can see.

G. H. Atkinson.

The hammer tube cleaner that Mr. Atkinson used was a DEAN, and with that cleaner he took out *1,000 pounds of scale in two days, although compounds were being used.* This kind of evidence is the kind that counts with the practical man and the power user who wishes to keep the boiler room expense down to the minimum, and this kind of evidence is *real*—not hot air.

THE SUPERIOR OF ANY OTHER MECHANICAL CLEANER ON THE MARKET, PROVING IN ITS USE THE FALLACY OF COMPOUNDS.

HERE IT IS

FOR WATER TUBE BOILERS

FOR RETURN TUBULAR BOILERS

THE WM. B. PIERCE COMPANY

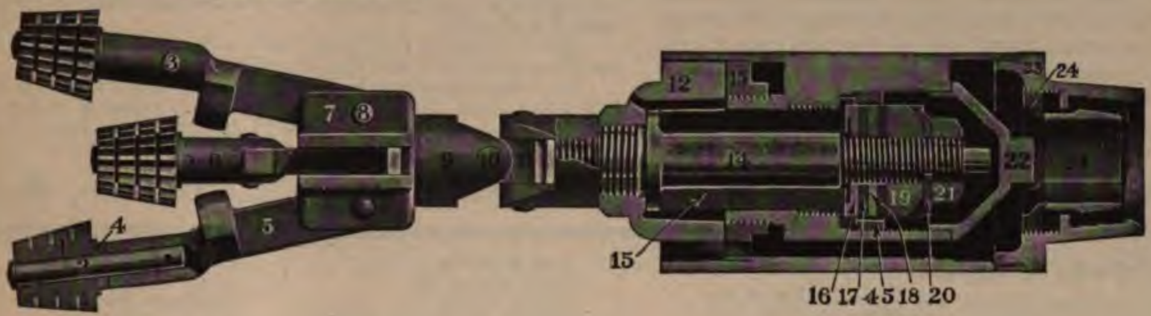
325 Washington Street BUFFALO, N. Y.

STOP!

Your Monkey Business

Get a "LIBERTY" Tube Cleaner

It will pay for itself the first time you clean your boilers and it will not cost so much to keep in repair as that flimsy affair you are now using, and besides, it will clean you tubes clean.



The "Liberty" Makes Boiler Cleaning Easy

as compared to your present antiquated method.

The "LIBERTY" Turbine Cleaner will clean your boiler tubes at less cost and in less time than is possible by the use of any other cleaning device in existence.

The "FABER" BLOW OFF VALVE "washes its face."
The TWIN STRAINER "strains continuously."
The FAMOUS OIL FILTER uses "the dry process."

Liberty Manufacturing Company,

4709 Susquehanna Street,
PITTSBURGH, PA., U. S. A.

THESE CLEANERS ARE WORLD-BEATERS

The "Torpedo" The "Demon"

THE "TORPEDO"
Removes all scale from tubes of fire tube boilers
Prolongs life of tubes
Centers itself in tube
Does not hammer but vibrates the tube
Is absolutely safe and easily operated
Has but one moving part
Will last a lifetime
Double Acting Vibrator
Automatic Centering Lugs

OPERATED BY WATER
THE "DEMON"
Removes all scale from tubes of water tube boilers
Is 42 times as powerful as turbine cleaners
Does not hammer or grind but cuts like lathe tool
Centers itself and cuts same top, bottom & sides
Adjustable cutter stops prevent injury to tubes
Rotary pistons are acted upon by direct pressure as in steam engine
Has roller bearings

For Fire Tube Boilers

Did you ever stop to think that approximately 95% of the heating surface in your boilers is in the tubes, and besides practically all these tubes are absolutely beyond possibility of human reach? If you could get a machine especially designed to remove all the scale from these tubes *inside the boiler* don't you honestly think it could save a pile of money, and prove a help in many ways? Then when you consider that a "Torpedo" could clean these tubes thoroughly and safely, as no other device can, and besides you can have one sent you on free trial just for the asking, really this is an opportunity you cannot afford to let go by a single day. Our printed matter tells some very interesting facts. Write for it or for a "Torpedo" on trial, if you prefer.

For Water Tube Boilers

Before we put the "Demon" on the market we made up our minds that a good water tube cleaner was sadly needed and the ideal form of cleaner was yet to come. The "Demon" is an IDEAL cleaner, because of:

1st—Its extraordinary power—by far the most powerful cleaner in the world.

2d—No scale is too thick or too hard to cope with. Thin or thick—all must go.

3d—Its marvelous rapidity. Its great power means quick work.

4th—The cleaner is made large and nearly fits the tube. Consequently the operator cannot get the machine through the tube until it is CLEAN.

5th—It removes that thin, hard, coal-heating scale that other machines pass over—and then it polishes the tube besides.

6th—Its cutters can never cut the tube because they just fit the tube when clean, the machine being always centered in the tube.

Shall we send you one on trial? If not, write today for our illustrated catalogue "E" describing the "Demon."

THE GENERAL SPECIALTY CO., 73 Carroll St., Buffalo, N. Y.

Classified Index for Buyers.

For addresses of manufacturers refer to the Alphabetical Index on page 49 which gives the pages on which the advertisements appear.

Air Compressors
Quincy Engine Wks
Snider-Hughes Co.
Air Compressors, Gasoline
Columbus Machine Co.
Alarms, High and Low Water
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.
Arches and Jambs. Boiler Door
Presbrey Fire Brick Works
Arch Plates, Boiler
Lamprey Co.
Automobile Fittings
Lunkenheimer Co.
Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.
Belting
Chicago Rawhide Mfg. Co.
France Packing Co.
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.
Blowers
Ohio Blower Co.
Snider-Hughes Co.
Boiler Compound Feeders
International Boiler Compound Co.
Boiler Door, Arches and Jambs
Presbrey Fire Brick Works
Boilers
Cooper Co., C. & G.
Harrison Safety Boiler Works.
Holyoke Steam Boiler Works.
Shilling, W. W.
Boiler Tube Cleaners, Mechanical
Bushnell & Co., John S.
General Specialty Co.
Lagonda Mfg. Co.
Liberty Mfg. Co-
Maurer, Labadie & Co.
Pierce Co., Wm. B.
Books
Audel & Co., Theo.
Engineers' Review Co.
Boring Machines, Electric
McCrea & Co., Jas.
Brass Founders
Lunkenheimer Co.
Williams Valve Co., D. T.
Brick. Fire
Presbrey Fire Brick Works
Calipers
Starrett Co., L. S.
Castings, Brass
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Chemicals
Lord Co., Geo. W.
Clamps, Pipe
McCrea & Co., Jas.
Clamps, Steam Joint
McCrea & Co., Jas.
Cocks
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.
Cocks, Gas
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.
Commutator Lubricants, Graphite
Dixon Crucible Co., Jos.
Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.
Compounds, Car Axle
Lubron Mfg. Co.
Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.
Compounds, Lubricating
Keystone Lubricating Co.
Condensers
Snider-Hughes Co.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.
Conveying Machinery
Borden & Selleck Co.
Cooling Towers
Wheeler Condenser & Eng. Co.
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Myers & Bro., F. E.
Crank-Pin Center Oilers
Lunkenheimer Co.
Nugent & Co-, W. W.
Crosshead-Pin Telescope Oilers
Nugent & Co-, W. W.
Cutters, Gasket and Washer
McCrea & Co., Jas.
Cutters, Tube
Lagonda Mfg. Co.
Cylinders, Artesian Well
Myers & Bro., F. E.
Cylinders, Irrigation
Myers & Bro., F. E.
Dividers
Starrett Co., L. S.
Disks. Rubber
Peerless Rubber Mfg. Co.
Dry Kilns
Ohio Blower Co.
Dust Collectors
Ohio Blower Co.
Dynamo and Motor Brushes, Graphite
Dixon Crucible Co., Jos.
Eccentric Telescope Oilers
Nugent & Co-, W. W.
Ejectors
American Injector Co.
Lunkenheimer Co.
Ohio Injector Co-
Penberthy Injector Co.
Engines, Blowing
Buckeye Engine Co.
Engines, Gas and Gasoline
Borden & Selleck Co.
Buckeye Engine Co.
Columbus Machine Co.
Engines, Gasoline Hoisting
Columbus Machine Co.
Engines, Hoisting
Quincy Engine Wks.
Engines, Steam
American Engine Co.
Bates Machine Co.
Buckeye Engine Co.
Cooper Co., C. & G.
Harris Steam Engine Co-, Wm. A.
Ohio Blower Co.
Quincy Engine Works.
Reeves Engine Co.
Russell Engine Co.
Exhaust Heads
Burt Mfg. Co.
Flower Filter Co., Walter L.
Ohio Blower Co.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Wright Mfg. Co.
Fertilizer Dryers
Anderson Co., V. D.
Filters, Oil
Burt Mfg. Co.
Flower Filter Co., Walter L.
Lippincott Steam Spec. & Sup. Co.
Maurer, Labadie & Co.
Nugent & Co-, W. W.
Pittsburg Gage & Supply Co.
Robertson & Sons, Jas. L.
Fire Brick
Presbrey Fire Brick Works
Filterers, Scale
Wright Mfg. Co.
Fittings, Brass Hydraulic
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Fittings, Steam
Lunkenheimer Co.
Sterling Lubricator Co.
Floats, High Pressure
Reliance Gauge Column Co.
Flue Cleaner Rods
McCrea & Co., Jas.
Flue Cleaners
Bushnell & Co., John S.
Cleveland Flue Cleaner Mfg. Co.
Robertson & Sons, Jas. L.
Ruggles & Ruggles.
Furnace Feeders
Ohio Blower Co.

(Continued on page 58.)

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CHESTNUT
Discharged Employes
Etc., Etc.

Again you are confronted with the "old Chestnut" that ther companies have employed our discharged and worthless x-employes, who claim to know how to make Rainbow. hese claims are absolutely false. The formula and manuacture still remain secret, known only to the President, Vice resident and Superintendent of the Peerless Rubber M'f'g ompany.

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(Continued from page 56)

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Holyoke Steam Boiler Works.
Fusible Plugs
Lunkenheimer Co.
Gage Glasses
Quaker City Rubber Co.
Gage Glass Reflectors
Lubron Mfg. Co.
Gage Glass Rings
Pennsylvania Rubber Co.
Gages, Oil
Lunkenheimer Co.
Gages, Steam
Lunkenheimer Co.
Ohio Injector Co.
Pittsburg Gage & Supply Co.
Gages, Recording
Pittsburg Gage & Supply Co.
Gages, Water
Lunkenheimer Co.
Penberthy Injector Co.
Powell Co., Wm.
Reliance Gauge Column Co.
Gaskets
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Gear Cutting
Chicago Rawhide Mfg. Co.
Gears, Rawhide
Chicago Rawhide Mfg. Co.
Generators
American Engine Co.
Governors, Pump
Albany Steam Trap Co.
Fisher Governor Co.
Foster Engineering Co.
Graphite
Dixon Crucible Co., Jos.
Graphite, Flake
Dixon Crucible Co., Jos.
Grate Bars
Bushnell & Co., John S.
Holyoke Steam Boiler Works.
Martin Grate Co.
Robertson & Sons, Jas. L.
Grates, Shaking
Lippincott Steam Spec. & Sup. Co.
Martin Grate Co.
Robertson & Sons, Jas. L.
Grease
Cook's Sons, Adam.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
Lubron Mfg. Co.
Grinders, Valve
Quaker City Rubber Co.
Hammering Machines, Die Plate
Bates Machine Co.
Heaters and Purifiers, Feedwater
Bates Machine Co.
Flower Filter Co., Walter L.
Harrison Safety Boiler Works.
Jacobs & Co., Chas.
National Pipe Bending Co.
Quincy Engine Wks.
Robertson & Sons, Jas. L.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.
Heaters, Hot Water House
National Pipe Bending Co.
Stewart Heater Co.
Heating Apparatus
Ohio Blower Co.
Hose
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Indicator Instruction
Indicator Instruction Co.
Indicators, Speed
Starrett Co., L. S.
Indicators, Steam Engine
Bushnell & Co., John S.
Lippincott Steam Spec. & Sup. Co.
Robertson & Sons, Jas. L.
Injectors
American Injector Co.
Lunkenheimer Co.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.
Lace Leather
Chicago Rawhide Mfg. Co.
Levels
Starrett Co., L. S.
Lubricators
American Injector Co.
Detroit Lubricator Co.
Greene, Tweed & Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.
Sterling Lubricator Co.
Williams Valve Co., D. T.
Lubricators, Automobile
Lunkenheimer Co.
Machinery, Coal and Ash Handling
Borden & Selleck Co.
Machinery, Conveying
Borden & Selleck Co.
Machinery, Oil Mill
Anderson Co., V. D.
Machines, Drilling
McCrea & Co., Jas.
Machines, Electric Boring
McCrea & Co., Jas.
Mats and Matting
Quaker City Rubber Co.
Micrometers
Starrett Co., L. S.
Mill Equipment, Wire
Bates Machine Co.
Motors
American Engine Co.
Nail Machines, Wire
Bates Machine Co.
Nail Rumblers
Bates Machine Co.
Oil and Grease Cups
American Injector Co.
Bushnell & Co., John S.
Detroit Lubricator Co.
France Packing Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Ohio Injector Co.
Penberthy Injector Co.
Powell & Co., Wm.
Williams Valve Co., D. T.
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Lunkenheimer Co.
Nugent & Co., W. W.
Oiling and Lubricating Devices
Lunkenheimer Co.
Nugent & Co., W. W.
Oiling Systems
Burt Mfg. Co.
Lunkenheimer Co.
Nugent & Co., W. W.
Pittsburg Gage and Supply Co.
Oils
Harris Oil Co., A. W.
International Boiler Compound Co.
Lubron Mfg. Co.
Standard Oil Co.
Vacuum Oil Co.
Packing, Metallic
France Packing Co.
Packing, Rawhide Hydraulic
Chicago Rawhide Mfg. Co.
Packing, Sheet and Fibrous
Chicago Rawhide Mfg. Co.
Crandall Packing Co.
France Packing Co.
Gould Packing Co.
Greene, Tweed & Co.
Lubron Mfg. Co.
Patterson Co., D. S.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.
Robertson & Sons, Jas. L.
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Mound Tool & Scraper Co.
Paint
Dixon Crucible Co., Jos.
Pencils and Crayons
Dixon Crucible Co., Jos.
Pinions, Rawhide
Chicago Rawhide Mfg. Co.

(Continued on page 59)

ntinued from page 58)

Cutting and
ading Machines
g Mfg. Co.
Machine Co.

eters
& Co., John S.
tt Steam Spec. & Sup. Co.
n & Sons, Jas. L.

ng Jacks
Bro., F. E.

, Air
Pump Co.
Condenser & Eng. Co.

, Centrifugal
Condenser & Eng. Co.

, Oil
Tweed & Co.
eimer Co.
& Co-, W. W.
y Injector Co.
Lubricator Co.

, Power
Bro., F. E.
Engine Wks.
Heater Co.

, Steam
Steam Trap Co.
Pump Co.
tt Steam Spec. & Sup. Co.
ughes Co.
Condenser & Eng. Co.

, Vacuum
Condenser & Eng. Co.

Steam
y Injector Co.

ing Wheels
& Co., John S.
tt Steam Spec. & Sup. Co.
n & Sons, Jas. L.

ators, Damper
& Co., John S.
Mfg. Co.
n & Sons, Jas. L.

ators, Feedwater
Mfg. Co.
Mfg. Co-

ators, Pressure
ngineering Co.

ing Machines
Mfg. Co.

Dressing
rface Co.

Transmission Wheels
achine Co.

r Goods
Rubber Mfg. Co.
City Rubber Co.

Steel
Co., L. S.

Fire
Fire Brick Works

Hack
Co., L. S.

k Selleck Co.

ators, Steam and Oil
Steam Trap Co.
Separator Co.
& Co., John S.
Filter Co., Walter L.
Safety Boiler Works.
Co., Chas.
tt Steam Spec. & Sup. Co.
wer Co.
n & Sons, Jas. L.
Heater Co.

s
Co., L. S.

Machines
achine Co.

Specialities
Co., V. D.
Mfg. Co.
eimer Co.
wer Co.
Gage & Supply Co.
Co., Wm.
Gauge Column Co.
Valve Co., D. T.
Mfg. Co.

Strainers
Liberty Mfg. Co-

Supplies, Engineers'
France Packing Co.
Lippincott Steam Spec. & Sup. Co.
Nugent & Co-, W. W.
Quaker City Rubber Co.
Reliance Gauge Column Co.

Tape Measures
Starrett Co., L. S.

Tools, Mechanics'
Starrett Co., L. S.

Tools, Scraping
Mound Tool & Scraper Co.

Traps, Air
Wright Mfg. Co.

Traps, Steam
Albany Steam Trap Co.
Anderson Co., V. D.
Flower Filter Co., Walter L.
Golden-Anderson Valve Specialty Co.
Lagonda Mfg. Co.
McCrea & Co., Jas.
Ohio Blower Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Trimmings, Engine and Boiler
Powell Co., Wm.

Tubing
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.

Unions
Albany Steam Trap Co.
Lunkenheimer Co.
Powell & Co., Wm.

Valves
Albany Steam Trap Co.
Foster Engineering Co.
Golden-Anderson Valve Specialty Co.
Lubron Mfg. Co.
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Powell & Co., Wm.
Williams Valve Co., D. T.

Valves, Blowoff
Lagonda Mfg. Co.
Liberty Mfg. Co-
Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.

Valves, Gate
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.

Valves, Non-return
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.

Valves, Pump
Lubron Mfg. Co.
Peerless Rubber Mfg. Co.
Pennsylvania Rubber Co.
Quaker City Rubber Co.

Valves, Reducing
Foster Engineering Co.
Golden-Anderson Valve Specialty Co.

Valves, Tuyere
Lunkenheimer Co.

Varnish
Dixon Crucible Co., Jos.

Watches
Engineers' Review Co.

Water Columns
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Lunkenheimer Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
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Flower Filter Co., Walter L.
Harrison Safety Boiler Works.

Water Testing Apparatus
Lord Co., Geo. W.

Whistles, Steam
Lunkenheimer Co.
Powell Co., Wm.
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Myers & Bro., F. E.

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If a packing possesses this essential qualification, a close joint is possible, even if a rod is scored, sprung or out of true.

A packing devoid of resiliency—give and take—is always hard in the stuffing-box, causes unnecessary friction, wears rods, wears itself and is never steam tight.

Crandall Packing

possesses in a high degree the give and take property and it is preserved as long as the packing lasts, by the wear resisting, friction reducing material it is made of, which is thoroughly impregnated by a special cold oil process with a high grade lubricant.

As regards both wear and resiliency, Crandall is a Give and Take Packing, in whatever style and for whatever purpose it is supplied.

It can be had in every style, for any purpose.

Style No. 295.
Expansion for Steam Hammers, Octagon Rods, Flat-sided Pistons and rods out of center.

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See that our name and trade mark is on every package.

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Palmetto Twist Packing

ou're ready to pack a half dozen sizes of small valve stems or spindles, and the beauty of it is you pack a stem or rod with Palmetto Twist, cked to stay O. K. for a while.

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Rubber and Friction

Put on a rubber glove and pass a piece of shafting through your hand, feel the resistanee you encounter, and imagine how much greater the frictional resistance where a rod moves rapidly, backward and forward, through a stuffing-box, tightly filled with a packing that presses rubber directly against the moving rod.

Where rubber is we naturally look for friction; they are hand and glove.

The manufacturer of rubber belting never fails to extol its non-slipping properties, very desirable—in belting.

On a slippery day your "rubbers," by creating friction, save you many a tumble in icy pathways.

Other cases in plenty could be cited, in which the practicable value of rubber is based on its friction producing properties.

Packing—good packing—should reduce friction. For to bring rubber into immediate contact with a moving rod is impracticable and unreasonable.

In Eureka Packing—the Genuine Eureka—this error is studiously avoided. Rubber is present in Eureka Packing as a rectangular core, acting as a cushion, but it never can come in contact with moving rod or metal surface. It is closely enveloped in a braided covering of long fibre flax, impregnated with a high grade lubricant. This takes all the wear, reduces friction and by protecting the rubber core, ensures permanent elasticity, one of the most valuable features of EUREKA PACKING.

EUREKA PACKING is made in a range of sizes that adapt it for all purposes. It is easily applied, lastingly durable and dependable under the severest conditions as to pressure and speed of moving parts.

Jas. L. Robertson & Sons

402 Fulton Street

NEW YORK

See our Steam Specialty Ad on Page 63

A Fine, Reliable Watc

makes as nice a present as you can buy

We are able to furnish you with a regular $15 watch in open face or hunting case, Elgin or tham movements, for $11 and $13 respectively. The open face, with either movement, $11, an hunting case with either movement, $13. Our profits on these are small, of course, but we ha arrangement by which it costs us practically nothing to handle them. We have sold hundreds of watches and well pleased customers have sold many more for us.

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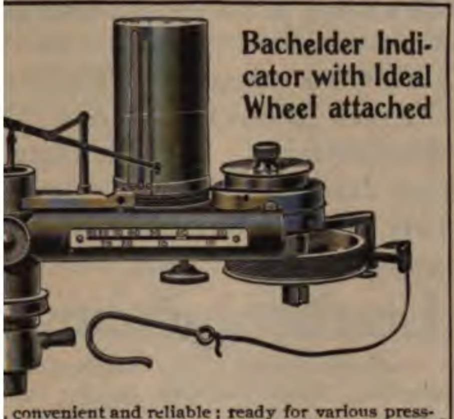

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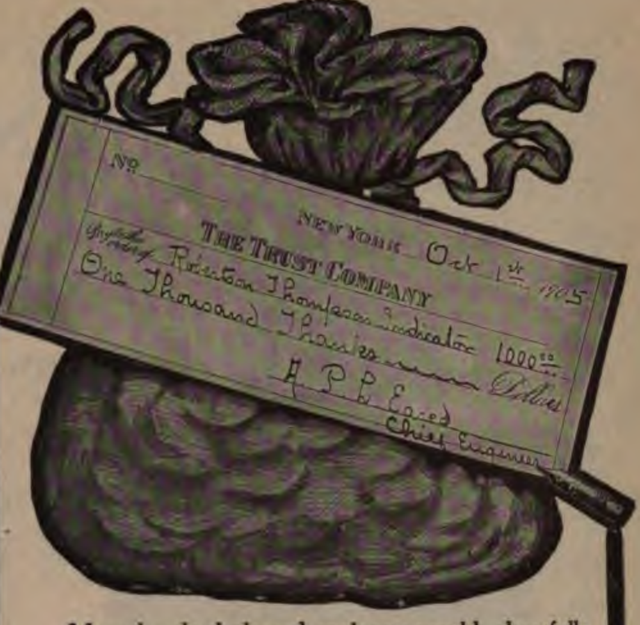
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NEW YORK Oct 1st 1905
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YOUR success depends on what you know. Can you find a device that will tell you more about your engine, more about things that you are responsible for, than an indicator?

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will enable you to read mean effective pressure direct from indicator diagrams, without recourse to time consuming, complex computations, which increase the possibility of error.

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Read what we say about Packing—Eureka Packing—on page 61

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Automatic Injectors

POSITIVELY the most efficient, durable and practical on the market. Satisfaction guaranteed. If your local dealer cannot furnish them, notify us.

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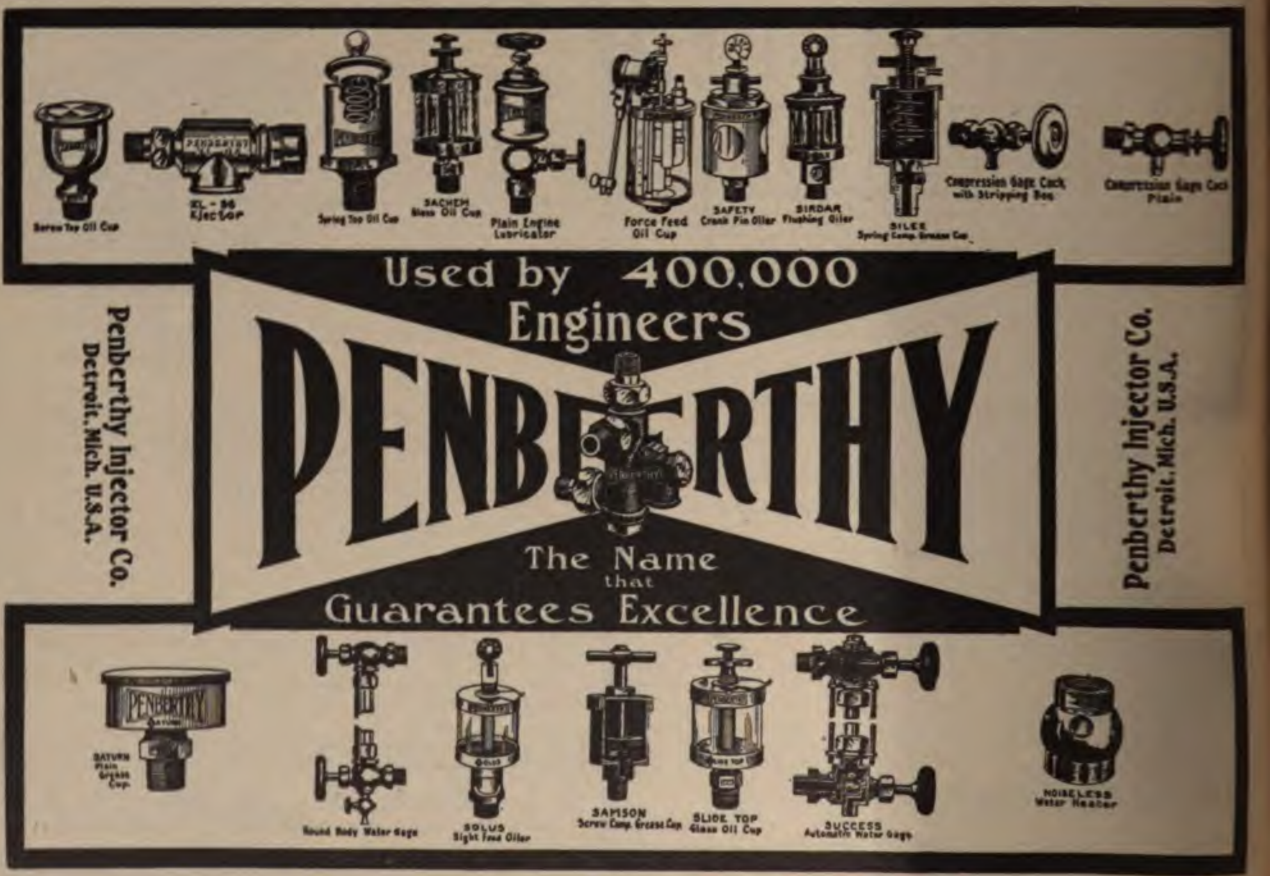

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MENTION ENG. REVIEW

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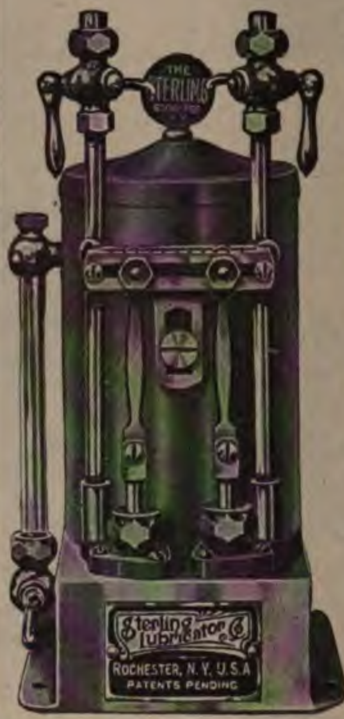

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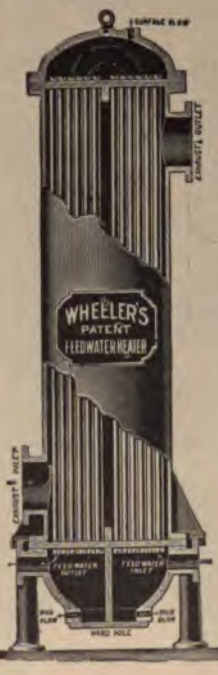

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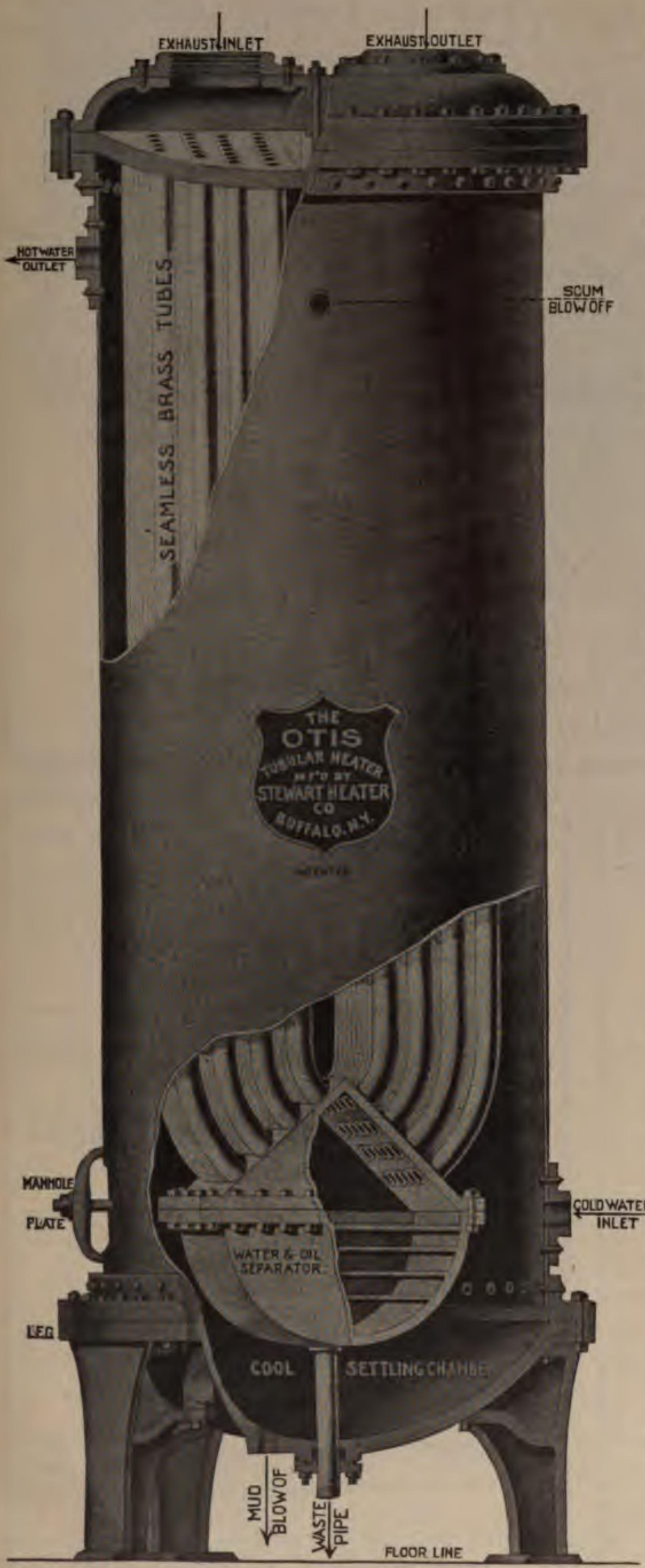

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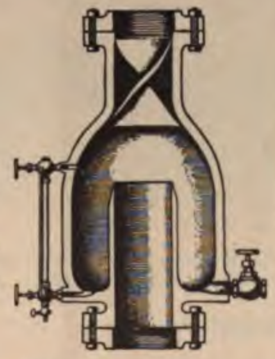

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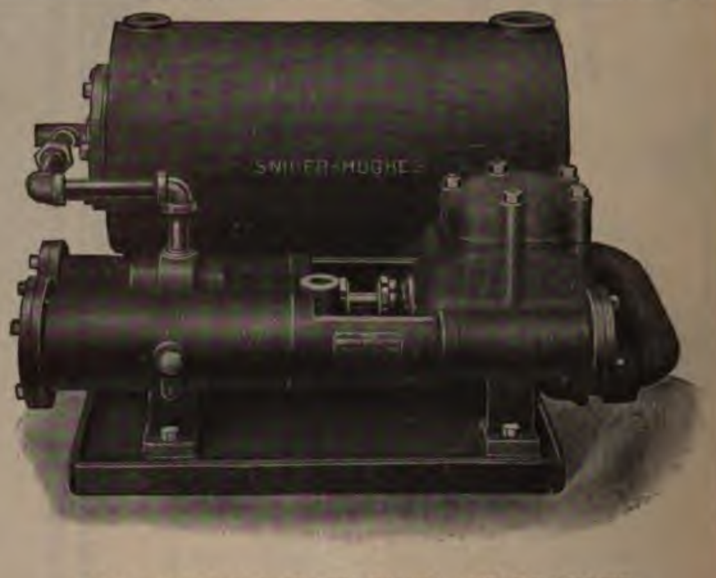

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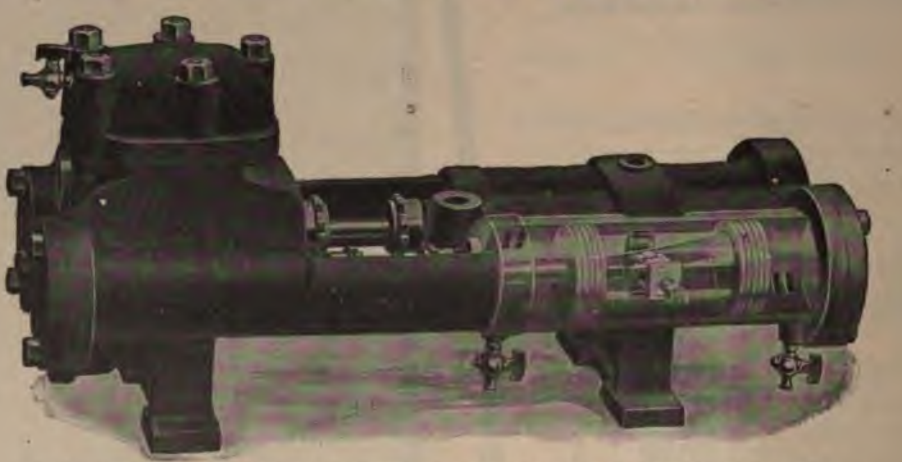

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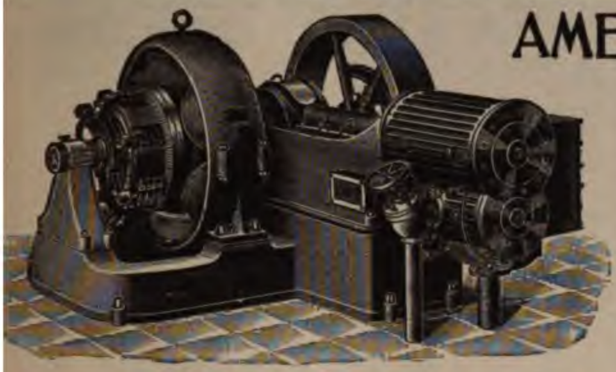

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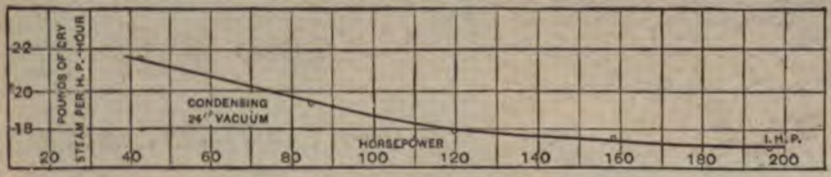

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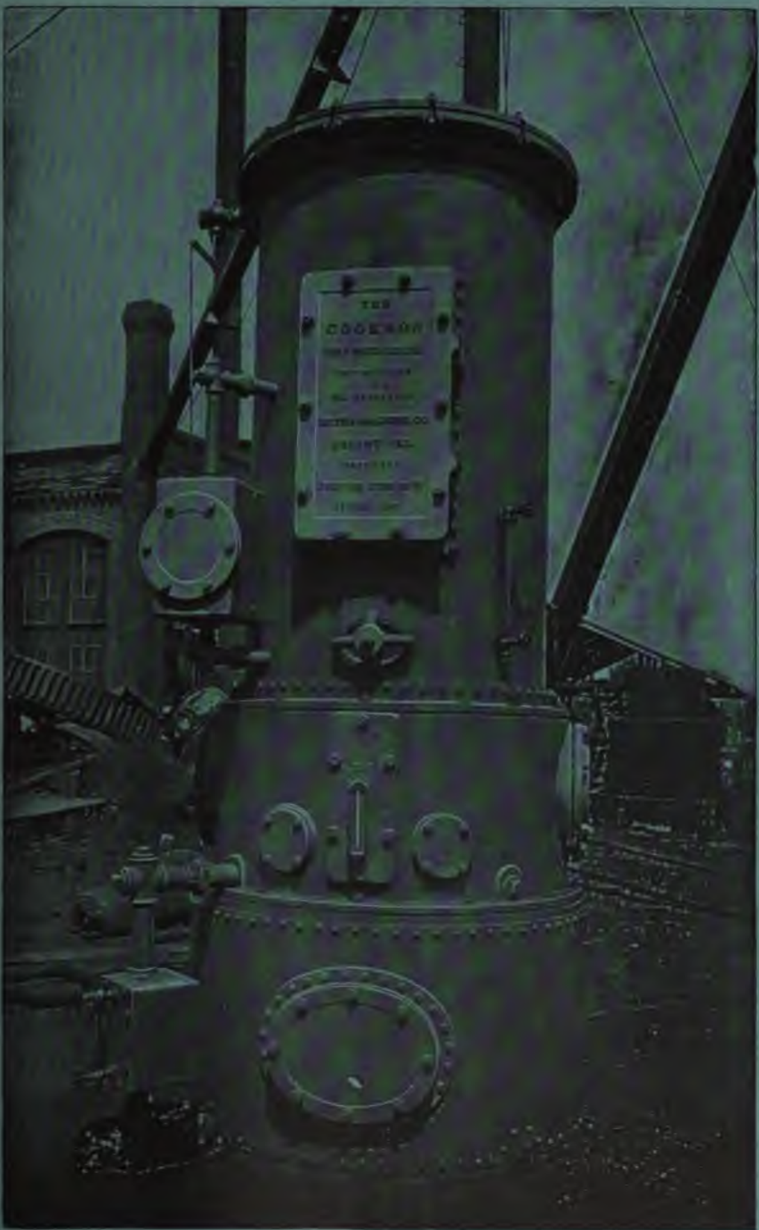

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ENGINEERS' REVIEW

CLEVELAND, DECEMBER, 1905.

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The Newsiest Article in this Number is,
The Allis-Chalmers Steam Turbine, Page 37.

Announcement

BEGINNING with the January 1906 issue the ENGINEERS' REVIEW will be made larger and better. It will be enlarged in two ways, size of sheet and number of pages. The present size which is 8½ x 11½ (an odd size which requires special cuts for the advertisements) will be increased to 9 x 12, the standard size. Eight more pages of reading matter will be added. The color of the cover will be changed to India Tint, which is the color between buff and white, and a heavier sheet will be used. A higher grade of white paper will be used inside as well.

But a new department which will begin in the January number will interest our readers most. In this department will be published a review or digest of all the most important articles on steam engineering subjects appearing in the technical press and technical society transactions. An addition has been made to our editorial staff to care for this work.

We are also pleased to announce that many special articles on live engineering subjects will be written for the ENGINEERS' REVIEW by well-known authorities.

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Philadelphia, Pa., U. S. A.

ENGINEERS' REVIEW

FOR STATIONARY ENGINEERS

VOL. 16. CLEVELAND, DECEMBER, 1905. No. 10.

THE LANE AND BODLEY FOUR-VALVE SHAFT GOVERNOR ENGINE.

The series of engines recently placed upon the market, by the Lane & Bodley Co., of Cincinnati, Ohio, have been designed to meet the demand which has arisen among a very large class of power users for a prime mover which occupies a minimum amount of floor space, and suitable for direct connection either to an electrical generator or line shafting, and having an economy in the use of steam comparable to engines using a detachable cutoff valve gear.

The illustration, Fig. 1, presents their new heavy duty, four-valve, shaft governor type of engine, equipped with rotary valves actuated by eccentrics and wristplates.

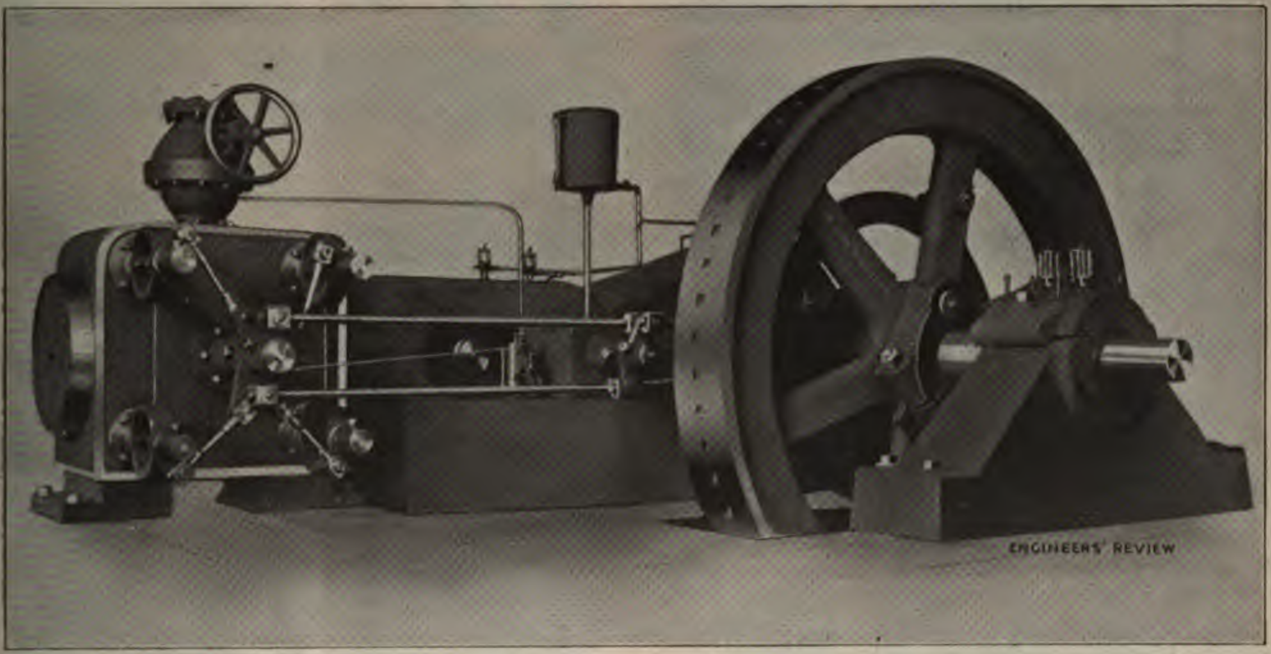


FIG. 1. THE LANE & BODLEY 1905 FOUR-VALVE SHAFT GOVERNOR ENGINE.

The frame, as shown, bears on the foundation through practically its entire length, and special attention has been given to the contour and distribution of metal so that this very important part of the engine shall possess the greatest possible amount of rigidity, and be capable of resisting the most severe shocks to which it may be subjected.

The cylinder is designed with an exceptionally large steam chest to act as a reservoir for the steam, thus keeping the pressure in the cylinder during admission more nearly that of the boiler. The exhaust chamber is separated from the walls of the cylinder by a liberal air space, so that no chilling effect shall be produced, as would be the case were the exhaust steam allowed in contact with the outside of the cylinder walls. Proper support is given by two feet which rest on the foundations, and are cast with the body of the cylinder.

In proportioning the wearing surfaces the data used has been such as would be obtained were the engine run constantly with an overload of 50 per cent and a boiler pressure of 150 pounds.

The main shaft dimensions have been made to conform to the standards presented by the American Society of Mechanical Engineers, for direct connected units, but the design is arranged to secure considerable flexibility in this regard, and other sizes can be substituted, should the conditions warrant.

An endeavor has been made to obtain the very best possible economy in the use of steam by giving close attention to the following details: steam distribution, leakage, condensation and clearance.

A very satisfactory steam distribution has been obtained by use of separately actuated steam and exhaust valves, advantage being taken of the wristplate motion to give an exceptionally large port opening very early in the stroke, and an almost instantaneous closure of both steam and exhaust valves. These very advantageous effects produced by the wristplate have been still further increased by the use of double-ported valves for both steam and exhaust.

Much of the loss of energy which occurs in the engine cylinder, heretofore attributed to cylinder condensation, has really been due to leakage of steam past the valves and piston. Great care has been taken to produce a design which would reduce this leakage to a minimum. Although fully aware of the advantages possessed in the matter of clearance by valves placed in the head, this design was abandoned on account of the impossibility of keeping the heads from springing at every admission of steam, thus producing serious leakage in the exhaust valve during admission and in both steam and exhaust valves after cutoff. This consideration, together with that of convenience in getting into the cylinder for inspection, led to the placing of the valves at the ends of the cylinder where neither of these objections hold good. Unbalanced valves have been used because the manufacturers believe that balanced valves are without exception open to the objection that from the moment they are put in operation the leakage begins to increase, while with an unbalanced valve the very fact that it is held in place by steam pressure is a guarantee that it will remain tight once it has become properly seated.

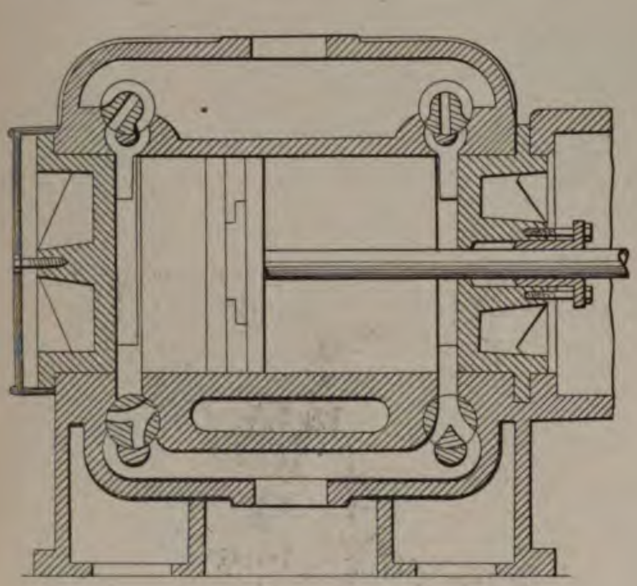


FIG. 2. SECTIONAL VIEW OF THE CYLINDER AND VALVES.

Internal condensation is directly proportional to the amount of internal surface exposed to the steam after it has passed to the cylinder, and all surfaces from the face of the steam valve to the face of the exhaust valve and admission side of the piston are so exposed. This surface is unnecessarily increased by badly designed ports, exhaust valves, pistons and cylinder heads; loosely fitted cylinder heads, and pistons designed with deep recesses for nuts will often in themselves increase this surface over 10 per cent. These details have received careful attention, and the surface presented for condensation has been reduced to a minimum.

The exhaust chambers of these engines are cast with a space separating them from the walls of the cylinders, and the cylinders covered with nonconducting material held in place by a neatly fitted sheet steel lagging, thus reducing the internal condensation. A cross section of the cylinder and valves is shown in Fig. 2.

The clearance has been reduced to the very smallest amount consistent with a port area capable of admitting steam to the cylinder with a piston speed of 800 feet per minute, and a maximum velocity of the steam in the ports of 8,000 feet per minute, and will not exceed 6 per cent for the shortest stroke.

The design has been worked out with a view to the greatest economy in the use of oil. In the cylinder the best possible drainage is obtained from the fact that the exhaust ports are at the very bottom of the cylinder. The bearing surface of the piston is ample for the weight, and the surest guarantee of economy in the use of cylinder oil are these two factors. All moving parts using oil are covered by sheet steel cases; or, as in the case of the crosshead; by the engine frame, and the oil caught either in the crank case, or suitable pockets so arranged that they may be piped to a filter. The valve gear is lubricated by grease applied by means of grease cups.

All exterior surfaces are smooth, with no corners or projecting ribs for the collection of dirt, making it difficult to wipe. Oil guards are all arranged to be easily and quickly removed. All parts of the cylinder needing inspection may be gotten at in the least possible time, and every bearing needing adjustment from time to time may be gotten at without having to remove oil guards or covers of any sort. Oil is fed to all external bearings from a central reservoir.

The regulation is obtained by means of a Rites inertia governor, which has become so well known in connection with high speed engine work that it needs no special mention. The governor is shown in Fig. 3.

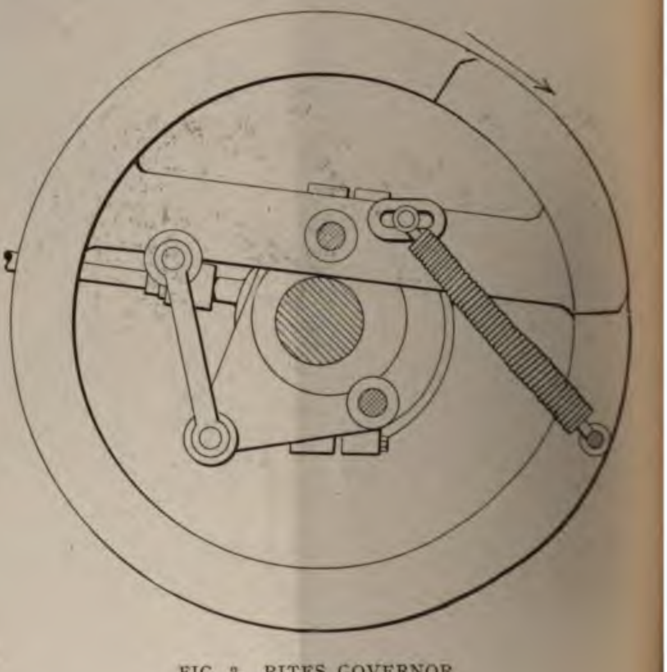


FIG. 3. RITES GOVERNOR.

The reason this governor can be used with unbalanced valves is because the travel of the double ported valves moved by the wristplates is small, and that during that portion of the travel when the valve is closed and steam pressure acting on it, the linkage is so arranged that a very powerful leverage is obtained to produce the slight motion which the valve has. The strain on the governor is, therefore, very little more than with a perfectly balanced flat piston valve, and much less than on these valves when leakage begins to take place.

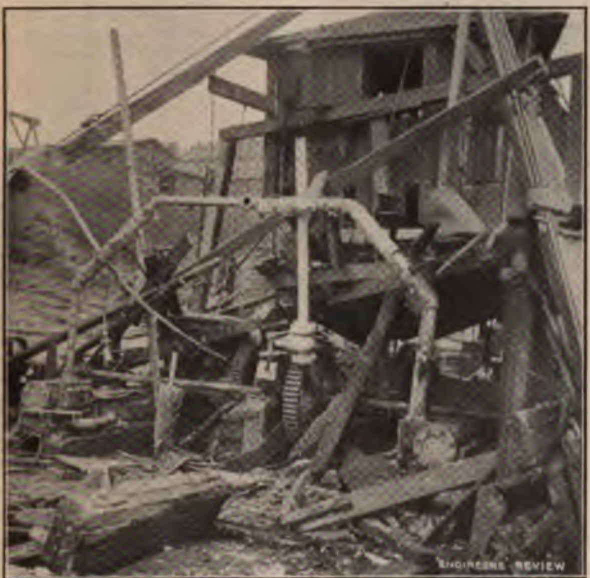
With these engines the cost of installation is very low, because of the small amount of floor space required, being for the simple noncondensing engines only 1 square foot per indicated horsepower for the smaller sizes, and ½-square foot for the larger sizes, the horsepower being taken at 100 pounds initial pressure and ¼-cutoff, and the high rotative speeds used. This reduces the size of foundations and generators required, and in very many cases allows the engine to be direct coupled to line shafting, and in case of belt driving very materially reducing the cost of belting.

These engines are especially recommended for direct connected service of all descriptions, for electric traction or any class of work where the load fluctuates very considerably and at short intervals and for isolated lighting plants, as in office buildings, hotels, etc.

The advantages are: High rotative speed, correct distribution of steam, close regulation, economy in the use of steam, oil and attendance, simplicity in construction, and small amount of floor space required.

UPRIGHT BOILER EXPLODES.

An upright boiler belonging to the Queen City Co.'s coal plant, Cincinnati, Ohio, exploded Nov. 9, instantly killing Richard Mullen, the fireman, and injuring Jerry Moore, a laborer, and Charles Weber, the enineer who was in the hoisting room at the time.



WRECK CAUSED BY THE BOILER EXPLOSION.

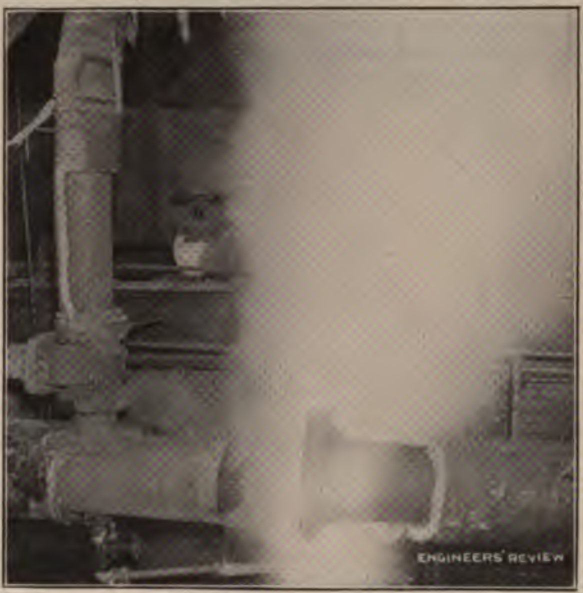
The boiler and engine were used for the purpose of operating coal diggers and were housed in a wooden shed located on a float or barge. When the boiler, which was of 75 horsepower exploded, it mounted high in the air and landed on the river bank 150 feet from its fastenings.

The fireman was found lying under the debris dead. On the outer side of the float close to the winch, Moore was found writhing in a cloud of steam. The photograph was taken shortly after the explosion and shows the wrecked engine and boiler house.

The cause of the explosion is not known. It is said that experts who examined the boiler after the explosion, found no indication of low water the first thing usually attributed to an explosion of this kind. The boiler was inspected three weeks ago and pronounced all right. The pressure carried ranged between 90 and 100 pounds per square inch, at which pressure the safety valve blew off. Prior to the explosion the valve had not operated.

FLANGE BURST IN THE POTOMAC ELECTRIC POWER COMPANY'S PLANT.

An accident which cost the lives of two men and injured six others, two seriously, occurred in the power plant of the Potomac Electric Power Co.'s plant, Washington, D. C., at about 2:30 a. m. Nov. 1, 1905.



SHOWING THE FLANGE WHICH FAILED.

An examination of the plant after the steam had cleared away revealed the fact that a 20-inch steam main had separated from the connecting flange about 19¼ inches. The flange was found to have cracked in five different places, which allowed the 20-inch main to withdraw from it. This pipe supplied the engines with steam and was located between No. 15 and No. 16 boilers. The appearance of the pipe after the explosion is shown in the photograph.

The general opinion is that the accident was caused by water hammer as the workmanship was good and the different connections were found to have been connected properly and erected in accordance with regulations governing pipe line construction.

The dead are Clarence Whitley and Wm. White. Whitley was a stoker and was scalded so badly that the flesh had fallen from the bones. White was found in the far end of an adjoining room between the machinery. He had evidently been blown from a point near where the pipe parted. His head was crushed and his face mashed no doubt from coming in contact with some part of the machinery as he was hurled through the air. Whitley was found near the entrance on the inside of the building.

The boilers carried a pressure of 180 pounds to the square inch, but at the time of the explosion the pressure was only 177 pounds. The pipe which pulled apart had been in use about three years and had never shown any sign of weakness. Steam was cut off from the pipe line about two weeks before the explosion, when connections were made to a new boiler.

In the opinion of those familiar with steam, the accident could not have been foreseen and could not have been avoided, or warning given to the men who were killed and injured.

CONSTRUCTING A 25-TON ICE AND COLD STORAGE PLANT.

BY D. L. FAGNAN.

In the construction of the cold storage and ice making plant it is advisable that the two departments be located in separate buildings, although the same machine may be used for both. It is better, also, to secure the highest class of insulation in any case. Of course, the first cost would be higher than if inferior insulation were used, but the first cost only occurs once, while if poor or ordinary insulations are used, the cost continues throughout the life of the plant, as maintenance charges are increased considerably under such conditions.

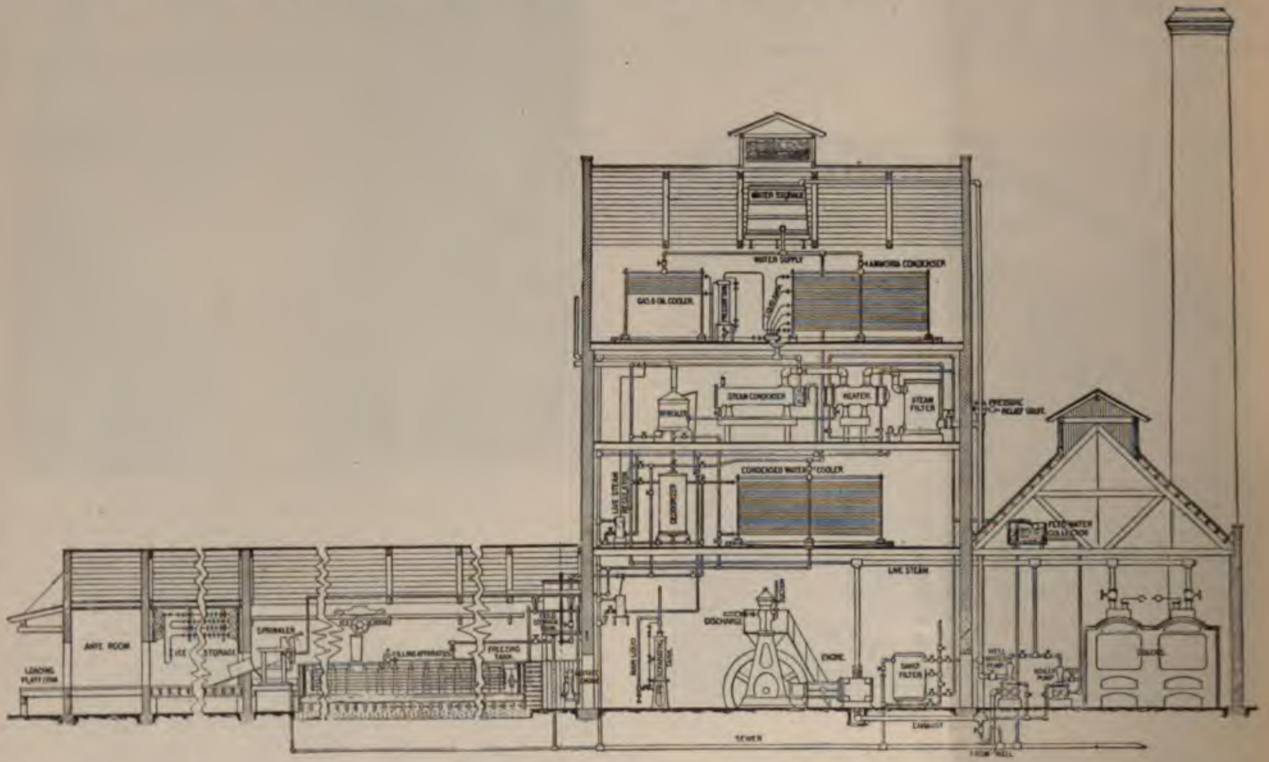


FIG. 1. ICE MAKING PLANT COMPLETE.

After having investigated many kinds of insulation and consulted expert refrigerating engineers and others, I believe that the best results can be obtained from felt insulation coupled with plenty of rubber cement work when constructing the walls. Everything used in construction should be made moisture proof—floors, ceiling, ante-rooms, etc. The cost of operation and the maintaining of temperatures as low as 16 degrees below zero, are below the average in all cases when the best insulations are used, but prohibitive when poor insulation prevails.

In designing a cold storage department, I favor the direct expansion piping in the rooms to be cooled, with two sets of piping for continuous operation and a three-way cock to control the expansion of the ammonia so that either set of coils can be in operation, while the other is thawing and open to the main pumping out line leading to the compressor.

This line should be connected by tees to the different condenser sections and also to the different apparatus using ammonia, such as the expansion coils, liquid receiver, liquid line and expansion valves, etc. By the proper manipulation of the valves any section or set of coils can then be cleared of ammonia without stopping the operation of the plant except for a short interval and without appreciable loss of ammonia. If the pipe line is properly installed the operator will get the best results throughout the system and he will be able to operate economically and well. If brine is to be used in the cold storage department, the cost of operating the plant will be somewhat higher than with the direct expansion piping, because a loss of efficiency occurs in the transmission of heat. This is because the ammonia must first cool the brine and then the brine must cool the room by absorbing heat. A loss occurs in each transformation similar to electrical losses in transformers, converters, etc.

In expanding gas direct, we can carry a higher back pressure, and consequently a greater weight of ammonia may be circulated per stroke and as the refrigeration produced is directly proportional to the number of pounds of ammonia circulated per 24 hours, a greater efficiency occurs with direct expansion than with indirect.

Indirect expansion refers to brine circulating in the cooling room to effect the refrigeration desired. There are cases where brine circulation, usually termed "indirect expansion," will prove the cheapest and best, namely, where the plant is to be operated days only, and where a fireman is left to care for the boilers and brine pump during the night. Under such conditions, the brine is cooled thoroughly during the day and the machines shut down during the night, the necessary refrigeration being produced by operating the brine pump. This method does away with an engineer on night shift during the winter season. When ice making and cold storage are combined the plant must be run continuously stopping only for accidents or repairs, etc. Hence nothing is gained by operating indirect, that is, circulating refrigerated brine through coils instead of the direct expansion system, where ammonia is circulated through the coils, when the plant is to be run continuously.

It is not a bad idea by any means to put brine coils in duplicates in the rooms to be cooled, as one set of coils can be shut off and allowed to thaw, while the circulation may go on through the other sets in the meantime. By this means, a more even temperature can be maintained than through the usual method of having only one set of coils and shutting them off completely when allowing the pipes to thaw off.

This method results in varying temperatures which are, to say the least, injurious and often fatal to some of the products kept in cold storage.

If direct expansion is used it is preferable to install a patent brine cooler, as it is the easiest to maintain and will prove the most efficient in service. It is stated by authorities, that with this apparatus 25 per cent saving can be effected over the usual methods of brine tanks with their coils of piping, insulations, leaks, etc. The patent brine cooler occupies but little space, a leak is a rarity and a lower temperature of brine is available with the same amount of ammonia circulated. This brine cooler refers to the cold storage department of the plant.

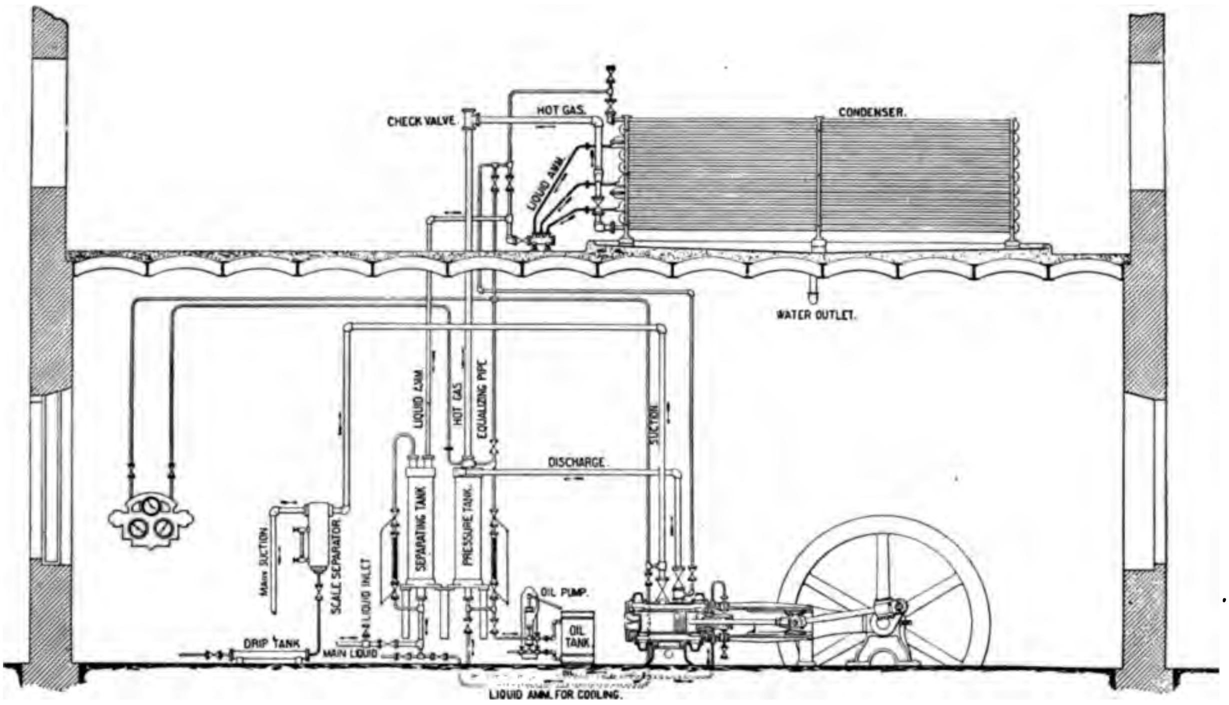


FIG. 2. REFRIGERATING PLANT, WITH HORIZONTAL COMPRESSOR.

With a plant designed as a cold storage and ice producer and with a competent engineer and assistant and well insulated apparatus it is safe to say that 25 tons of ice can be harvested daily and at the same time utilizing almost 10-ton refrigerating capacity in a cold storage department. If a less ice tonnage is required, a larger amount of refrigerating capacity could be credited to the cold storage department. One ton of ice making capacity is about equal to two tons of refrigerating capacity.

The machinery should not be crowded too closely together, but space should be left around the different apparatus so that each may be easily got at when necessary.

There are many different systems of refrigeration, but doubtless the De La Vergne system is as well known as any, the only radical difference between this and others in either ice making or refrigerating is the use of oil in the system. In the De La Vergne system considerable oil is used, while other systems use as little oil as possible. Good results are obtained from each system. It is simply a case of many men, many minds.

In regard to the ammonia condensers, there are cases where the double pipe condenser will prove the best installation, while in others the regular atmospheric condenser will be best. In this case the choice lies in the atmospheric condenser because in the making of ice, large quantities of water will be used, and if the plant is properly installed, it can be pumped over the ammonia condenser and from there to the steam condenser, which usually consists of long lengths of 6-inch pipe immersed in a shallow tank with a back pressure valve attached. Thence to the fore-cooler, a portion of the hot water being piped to the can dumps, etc. The boiler feed pump can take water at the top of the steam condensers and force it through the feedwater heater and thence to the boiler at a high temperature, the remainder going to waste. Sometimes this waste is piped into wells where the water supply is insufficient, thus helping in the flow of water in the regular wells.

In Fig. 1 is shown a plan of an ice making plant complete. This diagram is taken from the plans originated by the De La Vergne Co. In case the compressor is desired to be driven by belt, modifications can easily be made to suit the individual wants. In Fig. 2 is shown a complete refrigerating plant of the same company's design. This should help those who are contemplating either one, or a combination of both to design a plant which should give satisfactory results. The same modifications mentioned in Fig 1 may be applied to Fig. 2. In installing plants as large as 25 tons of either ice making or refrigerating capacity, a direct connected machine would be a much better arrangement than belting, etc.

GAS ENGINES IN POWER PLANTS.

BY WM. T. MAGRUDER.

Extracts from a paper read before the Ohio Society of Mechanical, Electrical and Steam Engineers at a recent meeting.

From the testimony of many witnesses who have had practical experience it would seem to have been repeatedly demonstrated that the best modern gas engines have many advantages over other forms of prime-movers in the production of power for the generation of electricity, for the operation of pumping machinery and for manufacturing purposes. Among these may be noted the very low cost of the fuel consumed per unit of power generated; the low cost of operation and maintenance; the simplicity of the equipment; the facility for quick starting; there are no standby losses to provide for; the light load efficiencies are equal, if not superior, to those of the reciprocating steam engine; the waste heats of the jacket water and exhaust gases can be profitably utilized in manners similar to the various ways now in use for utilizing exhaust steam; there is no danger from steam boiler explosions; the excess of latent energy generated from the fuel during light loads can be stored in the form of gas in the gas holder more economically than in any other form or by any other means; the largest possible units are not demanded in order to obtain a reasonably large efficiency and economy, but on the contrary, gas power lends itself to the generation of power in small units; and lastly, the reliability of the plant for both intermittent and continuous operation under either constant or variable loads.

As to the cost of fuel, with natural gas at 8 cents per 1,000 cubic feet, the chief engineer of a large power station informs me that for a period of three months, the cost of gas was less than 2 mills per kilowatt hour, or less than 1½ mills per brake horsepower per hour, and that the total cost of fuel, labor, oil, waste and supplies was 4 mills per kilowatt hour, or 3 mills per horsepower hour. These figures are almost equaled by tests of plants using suction gas generated from anthracite coal at $5 a ton. Even in smaller plants, the amount of fuel used under average conditions should not exceed 1½ pounds of coal per brake horsepower per hour, and the cost of same should not exceed 3 mills per horsepower with coal at $4 a ton. Not a few suction gas producer power plants have delivered one brake horsepower for less than 1 pound of anthracite coal burned per brake horsepower per hour. Where crude or waste oil are obtainable, the gas power plant reduces itself to simply an oil engine, an oil reservoir and a pump; and when the price of fuel oil is normal, the cost of fuel is reduced to less than ½-cent per hour per unit of power.

In power plants, the gas engine need have but three auxiliaries, namely, a small air compressor for starting the engine, a magneto, or dynamo, for producing the current required for the electric ignition of the charge of air and fuel, and a circulating pump for the jacket water.

Steam engineers, when inspecting gas power plants, cannot help but be struck with the absence of pumps, feedwater heaters, injectors, economizers, tall chimneys, superheaters, separators, condensers, vacuum pumps, both dry and wet, and the necessary piping and fixtures required by them, and which are all missing from the ordinary gas power plant.

When it comes to the starting of an engine, the gas engine is excelled only by the air engine, as the time required for starting it and getting it up to speed is less than that required to start a water engine or a steam engine.

No steam engineer could think for a moment of attempting to start up a cold steam engine in the 30 to 60 seconds required to start a gas engine and get it up to speed at full load. After one has seen gas engines up to 1,000 horsepower started, and the full speed attained in 45 seconds by the watch, one begrudges the time necessary to warm up the cylinders of a steam engine of the same power.

The standby fuel consumption in a steam power plant sometimes reaches 10 per cent when the pressure has to be maintained continuously. In a gas power plant, using either oil or gas from a general main, the standby losses are entirely absent. In a gas power plant which generates its gas in its own gas producers, the fuel consumption when the engine is not running should not exceed 10 pounds per hour for each producer, owing to the fact that the producer has no tall chimney to create such a draft as would cause the ordinary boiler dampers to leak badly. It is for these reasons that gas power has been chosen and is preferred to operate the fire pumps, not only of mills and factories, but also of city districts.

The light load efficiencies of gas engines vary as much among them as do the efficiencies of different classes of steam engines under similar conditions. Being similar in construction, it would seem reasonable to suppose that the costs of running light would be about equal in the two kinds of engines. Tests and experiments seem to confirm this suspicion.

As from 30 to 50 per cent of the latent heat of the fuel used in a gas engine is carried away in the sensible heat of the jacket water, it requires but little genius to suggest that this hot water could be utilized in laundries, in dryhouses, and for hot water heating. As from 30 to 50 per cent of the latent heat of the fuel usually passes off through the exhaust pipe, it has been repeatedly suggested that this heat should be used by causing the hot exhaust gases to pass over heating surfaces surrounding, or containing, either the hot jacket water, or additional water which it was desired to heat; or else that the heat be used in raising steam for use in steam engines or in steam heating, or for such other purposes as might be desired. These suggestions have been carried even to the extreme of constructing and operating an engine, one end of whose cylinder is used as a gas engine, and the other end of the same cylinder, acting as a steam engine, using the steam generated from the hot jacket water by the products of combustion of the fuel burned in the gas engine end of the cylinder. When it is remembered that the exhaust gases not infrequently leave the gas engine cylinder at a temperature of from 1,000 degrees to upwards of 1,500 degrees F., it is quite evident that such a scheme is perfectly possible. As the use of the fuel in a gas engine is more efficient than in a steam plant, there is of necessity a smaller waste of heat which can be utilized for hot water heating and the like, and for this reason gas power has no advantage over steam power as a system of heating, for the same reason that you "cannot eat your cake and have it too."

So far as I know, it has never been claimed for gas engines that they are fool-proof, nor that it was impossible to wreck them.

Gas engines have been known to go to pieces in the same way that steam the engines have gone to pieces but usually through no fault of engine. In any case the damages done were not to be compared to those of a steam boiler explosion.

It is well known that the commercial efficiencies of small steam engines are very much less than those of large engines. This is chiefly due to the extra first cost and to the cost of maintenance and of operation of the many auxiliaries by means of which the lesser steam consumption is obtained in those plants having large units. Such is not the case with the gas engine to such a marked extent; hence, the gas engine lends itself to subdivision, and as a result partakes of all the cost and to the cost of maintenance and of operation. The ease with which gas and oil may be piped from a. central source to the different engines, causes this system of power transmission to have many advantages which are surpassed only by transmission of power electrically.

The reliability of a gas power plant is dependent upon the character of the installation and the ability of the engineer in charge to keep it up to its highest perfection of operation. In these regards the gas engine does not differ from the other forms of prime movers, or from other machinery. That gas engines are reliable when in proper hands can be easily proven by the numerous records of engines which have run continuously night and day without stopping for many months at a time.

If the above are some of the arguments which can be properly adduced for the use of the gas engine in power plants, I desire to ask the question, What are the causes which so far have prevented their more general introduction? Is it because the first cost of a gas power plant may slightly exceed the cost of a steam power plant of the same capacity? If so, the answer is that the increase in saving of fuel will more than pay for the difference under the usual set of conditions. Few general managers prefer to earn only 10 per cent on an investment of $10,000 when they could earn 20 per cent on an investment of $12,000 for the same purpose. If, because the gas engine in large units is still something of a novelty, the reason is ignorance or prejudice.

NATURAL GAS UNDER STEAM BOILERS.

BY JAY M. WHITHAM.

Extracts from a paper read at the New York meeting (December, 1905) of the American Society of Mechanical Engineers.

The writer was recently called upon to give an opinion regarding the commercial operation of a particular mill, both with natural gas and with coal, at a certain price. No detailed data of any special or determinative value could be found in available handbooks and other publications. This paper has been prepared to put on record the results of the author's investigations so as to aid engineers in reaching a fair conclusion on the problem from a commercial standpoint.

The August 7, 1905, Press Bulletin, No. 192, of the U. S. Geological Survey, shows that the value of the present natural gas production of 19 States and Territories of this Union, exclusive of the natural gas produced in Canada and consumed in the States, was $38,496,760 in 1904.

In making this figure, Pennsylvania stands first with a product valued at $18,139,914; West Virginia is second, with a product valued at $8,114,249; Ohio is third at $5,315,564; Indiana fourth at $4,342,409, while various other States and Territories make up the balance.

Most of this gas is used for combustion purposes, and much of it for steam production. Hence any information as to the use of such gas in steam generation may be of interest and value.

The composition of natural gas varies somewhat with the locality. The heating values of natural gas per cubic foot, vary from 1,037 to 1,287, being referred to 32 degrees F. and 29.92 inches Barometer.

In any test, for any purpose whatsoever, of the use of natural or other gas for a useful effect, it is important that the amount used shall be truly determined. The gas meter can best be tested by the following method employed by the Equitable Meter Co., of Pittsburg, which method appeals to the writer as being complete and exact. It is described by the company's engineer, Mr. George W. Barnes, as follows:

"The testing apparatus we use, in lieu of a better name, we call a *flow meter*, and it is constructed as follows: First we have an inner cylinder, 24 inches by 24 inches, perforated with as many ¾-inch holes as it will contain. Outside of this perforated cylinder we build another cylinder perforated with carefully calibrated holes of 1½-inch diameter, and of a sufficient number to give us a volume sufficient to test a meter using 250,000 cubic feet per hour. The rest of the apparatus is simple, consisting of gages and a blower of sufficient size to give us the required volume of air at the required pressure.

"These holes in the outer cylinder or drum will discharge at a 4-inch water pressure and at a temperature of 60 degrees F. and a barometric pressure of 30 inches, *one cubic foot per second*, or 100 cubic feet in 100 seconds.

"Our connections are made up as follows: We connect the meter to the outlet of the blower and our *flow meter* to the outlet of the meter, and operate our blower continuously and govern our pressure by a regulator placed between the blower and the meter. Our pressure is taken from the outlet of the *flow meter*, and the temperature is obtained at the same point. If the conditions are all as just stated, we maintain the pressure of 4 inches of water pressure. If either the temperature or the barometric pressure vary from the above, we vary our pressure to suit the conditions, thereby maintaining a constant flow of *one cubic foot per second for each hole*, in the shell of the outer drum. We then take time with a stop-watch, allowing the meter to run 100 feet, when we note the time required. If more or less than 100 seconds are required, the error is computed from the 100 seconds, and an adjustment is made in the meter, and the corrections are made accordingly. The run at one 1½-inch hole or outlet will give a test on a meter at a flow of 3,600 cubic feet per hour. After making the above test we remove the stopper of another 1½-inch hole and make the flow at the rate of *two cubic feet per second*, or 7,200 cubic feet per hour, or two revolutions on the 100 foot dial of the meter in 100 seconds, and correct as above noted. This we continue to do in multiples of 3,600 cubic feet per hour until the full rate of capacity of the meter has been reached and adjustments have been made at each period through the run.

"This method we think the most nearly perfect to be had, inasmuch as it is gives us our tests upon the meter with the actual volumes as required in general service.

"The formula used in determining the pressure required with different temperature and barometric pressures was arrived at by making the runs through the orifices from an accurately calibrated *displacement* prover. The experiments covered a period of some 18 months and have been tried under all of the varying conditions obtainable during that period, while we have also checked back by the formulae to the barometric reading, temperature and pressure, where each was obtained accurately from instruments, and in all cases we have proved that our formula was absolutely correct for the aforesaid 1½-inch orifices."

The writer has investigated several of the gas burners upon the market and concludes that there is but little difference between them from an efficiency standpoint.

The following boiler tests made separately with 10 Gwynn and 10 Kirkwood burners supplying a 250-horsepower Cook water tube boiler, having a "dog-house" furnace, the burners being placed in the front and at a level slightly above the furnace doors, the furnace having an imperfect "check-wall" in each case,

f flame	White.	Blue.
250-horsepower Cook boilers d	6	6
e gas pressure at burners, oz.	6	6
feet of gas used when reduced 4 ounces and 60 degrees F.	626,815	561,638
lent water evaporated from d at 212 F., pounds	496,163	441,963
e boiler horsepower made	1,597.7	1,423.2
ower made per 250-horsepower ler	266.3	237.2
feet of gas reduced to 4 ounce ssure and 60 F. used per boiler rsepower per hour	43.6	43.8
f burners	Kirkwood.	Kirkwood.
lids	Throttled.	Open Wide.

six tests when thus consolidated in two tests that the *economy* is the same with each and that *pacity* is greatest with the white flame.

ts of a 302-horsepower vertical Cahall boiler, at ield, Ohio, were made by J. Roland Brown, who butes the following tests made with six Merrill rs, the boiler having 3,021 square feet of heating e.

n, hours	7	10
f test	Mar. 2, '03.	Mar. 5, '03.
gage pressure, pounds	95	85.7
n front of damper, inches	0.28	0.7
essure, ounces	4.8	7 to 30
ter and gas temperatures are given	....	....
ter temperature, degrees F.	46.5	53.3
y	406	374
eet of gas used	100,700	88,370
evaporated, pounds	67,865	74,168
lent water from and at 212 de- es F., pounds	82,171	89,076
horsepower made	340.2	260
feet of metered natural gas d per hour per horsepower	42.26	34

last test was made with gas at a high pressure, g from 7 to 30 ounces, and the average pres- not stated.

Daniel Ashworth, Member, has contributed the ing results of tests made by him with various rners on a 2-flue horizontal boiler:

No.	Gas Pressure at Burners in Ounces.	Name of Burner.	Cu. ft. of Natural Gas per hr. per Boiler H. P. Made.
1	0.76	Hoffmann	58.0
2	0.76	Hoffmann	59.7
3	0.34	Reno	67.0
4	0.34	James	63.0
5	2.00	Miller	74.0
6	1.10	Bailey	47.0

tests here given show that it is not possible better efficiency with natural gas than with coal, ove rather that the best coal efficiencies can not ained with gas. That is due to the large volume r for dilution" which must be supplied with gas s. On the Cook boiler test, No. 799, the Orsat d: 7.8 per cent of CO^2, 8.05 per cent of oxygen, er cent of CO, 84.15 per cent of nitrogen, mak- otal of 100.00 per cent for the composition of the ts of combustion at the boiler damper when er cent of the heating value of the gas was ab- by the boilers for evaporation.

h a poor analysis is almost an impossibility with iler when burning coal.

To produce a boiler horsepower 966 × 34.5 = 33,327 British thermal units must be absorbed by the water in the boiler. Assume that, on an average, natural gas has 1,100 British thermal units per cubic foot. Then, if the gas is burned at 100 per cent efficiency, 33,327 divided by 1,000 = 30.3 cubic feet of gas must be used per horsepower per hour. Yet tests are sometimes reported where from only 17.4 to 19.8 cubic feet were used per hour per boiler horsepower.

Assuming 75 per cent to be the best efficiency obtainable with natural gas under boilers (and this is very difficult), then 30.3 divided by 0.75 = 40.4 cubic feet of gas, at normal barometer and temperatures, which must be used per hour per boiler horsepower.

In summing up we find:

There is but little advantage possessed by one burner over another.

As good economy is made with a blue as with a white or straw flame, and no better.

Greater capacity may be made with a straw-white than with a blue flame.

An efficiency as high as from 72 to 75 per cent in the use of gas is seldom obtained under the most expert conditions.

The "air for dilution" is greater with gas than with coal, so that possible coal efficiencies are impossible with gas.

Don't expect, in *good commercial* practice to get a boiler horsepower on less than from 43 to 45 cubic feet of natural gas, the same being referred to 60 degrees F. and 4 ounces pressure above a barometer of 29.92 inches.

Fuel costs are the same under best conditions with natural gas at 10 cents per 1,000 cubic feet and semi-bituminous coal at $2.87 per 2,240 pounds.

This is based on 3.5 pounds of wet coal being used per boiler horsepower per hour or 45 cubic feet of natural gas.

Expressed otherwise, a long ton of semi-bituminous coal is the equivalent of 28,700 cubic feet of natural gas; while a short ton of such coal is the commercial equivalent of 25,625 cubic feet.

As compared with hand firing with coal in a plant of 1,500 boiler horsepower output, coal being $2.00 per 2,240 pounds—considering labor saving by the use of gas—natural gas should sell for about 10 cents per 1,000 cubic feet.

The Horsepower of Steam Turbines.

"An instrument for finding the power of a steam turbine," says the *Mechanical Engineer*, London, "has been designed by Mr. Johnson, of Messrs. Denny & Brothers, Dumbarton. The action of the instrument is said to depend on the measurement of the torsional deflection of a given length of shaft, which will, of course, vary with the power transmitted. Such measurements must, however, be very delicate to be of value, while the deflection will obviously depend on the nature of the material, as well as the twisting force. It is difficult, therefore, to see how an exact standard of comparison can be established, and it will be interesting to know the results of the tests which, we understand, the admiralty has recently been making with the instrument on board a torpedo destroyer."

INDICATOR PRACTICE.

MEASURING DIAGRAMS BY PLANIMETERS.

By W. H. Vincent.

In a late article, methods for obtaining the mean effective pressure of indicator cards by finding the average height of the diagram, or mean ordinate were explained. In this paper two types of planimeters will be discussed which are perhaps the most used of any.

The area of a diagram may be found in square inches by means of an instrument designed especially for this purpose, which area divided by the length of the diagram will give the average height. This method of obtaining the mean ordinate is by the use of an instrument called the planimeter. The first form shown is that of the Amsler shown in Fig. 1. It consists of two arms hinged at *A,* the guiding arm *AB,* having a needle point as shown, which acts as a pivot. The tracing arm *A C,* has a point for tracing the outline of the diagram.

At *E,* on the tracing arm, is a measuring and recording wheel. The roller is divided circumferentially into 10 equal parts, each of which represents a square inch of area, these parts each being further divided into equal parts, each representing one-tenth of a square inch as shown in Fig. 2.

Close to the edge of the roller is a stationary piece *F,* having the same curvature and containing a vernier made by dividing a space nine-tenths as long as one of the larger divisions of the roller, into ten equal parts. To illustrate this, let the space between *G* and *H,* Fig. 3, represent one of the largest divisions of the wheel, and the space between *I* and *J* the vernier. In reading the instrument take the number on the wheel that has passed the zero mark on the vernier, when the wheel is turning to the left as indicated by the arrow. The number of whole square inches is, in this case, 5.

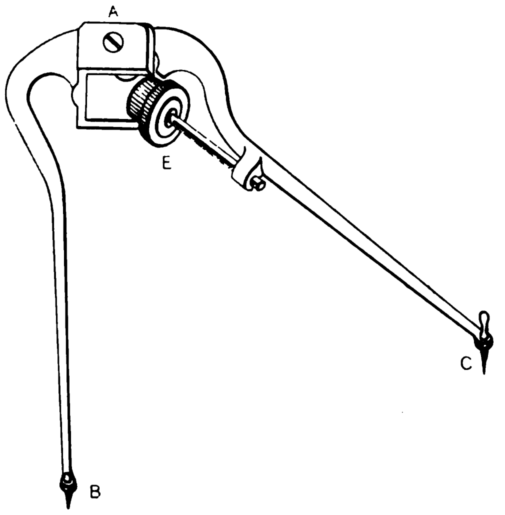


FIG. 1. AMSLER PLANIMETER.

The tenths of a square inch are indicated by the number of spaces as shown by *K,* which have passed the zero mark, in this case 1, so that the reading of the scale, as laid down in Fig. 3, is 5.1 square inch. It will be noticed that the space between the line *L* and the line *1* on the vernier is just one-tenth of one of the spaces, such as *K* upon the roller; the space between the line 2 and *M* is two-tenths, between 3 and is three-tenths and so on, therefore if the wheel is rolled in the direction of the arrow, one-tenth of one of the spaces *K* corresponds to an area of 1- one hundredths, and 2 *M* will indicate 2 one-hundredths, so that we get the hundredths of a square inch by writing that number of the vernier opposite any line on the wheel.

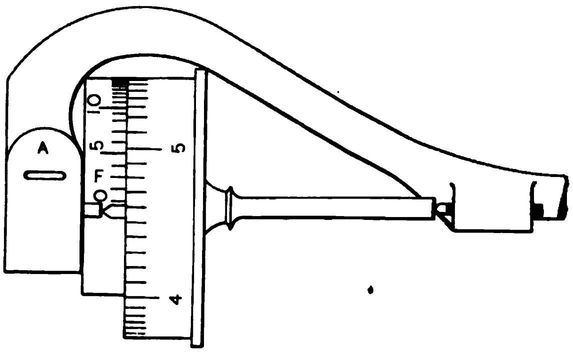


FIG. 2. SHOWING DIVISION ON AMSLER ROLLER.

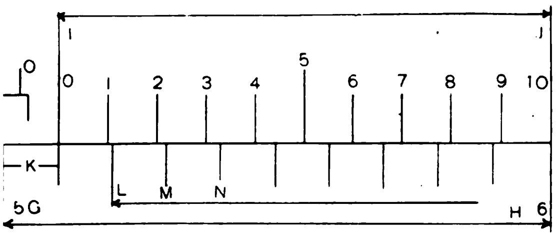
For instance in reading the instrument as it stands in Fig. 2, we first write the number on the wheel to the left of the zero mark, which is 4, then the number of whole spaces between that number and the zero mark, in this case 6, and the last number on the vernier which is in line with the mark on the wheel is 3, reading to the right. The whole reading, therefore, will be 4.63 square inches, the decimal place being placed after the 4, the 63 being hundreths as already explained. It will be noticed that only the zero 5 and 10 are numbered on the vernier in Fig. 2. This is because the intermediate marks are easily known by their position. With a little practice in the use of the instrument it soons become easy for the operator to quickly determine the mark on the vernier which coincides with one on the wheel. The marks at either side of it being just within the marks upon the wheel give the arrangement as shown at *O,* Fig. 3.

The proper use of the planimeter will reduce any irregular surface to a parallelogram or square by observing its reading carefully, measuring by means of the pointer and then reading from the index wheel and vernier and obtaining the value as indicated by simply adding or subtracting as explained.

The paper upon which the diagram is placed should be large enough to include the planimeter also, and fasten with thumb tacks, then set the stationary point of the planimeter *B,* Fig. 1, on the board or table in such a position that the tracing point *C* can be carried around the outlines of the diagram without bringing the wheel in contact with the card. It is better to so work the instrument, that it will not close up too closely or extend too widely, but to be placed in a position so that the motion roller will be easiest when the arms are near a rectangular position.

It may be found advisable in order to prevent the wheel from coming in contact with the top edge of the card, especially where the areas to be measured are or where there is considerable space between p of the diagram and the top edge of the card, vert the diagram or place it on the board with ttom side up.

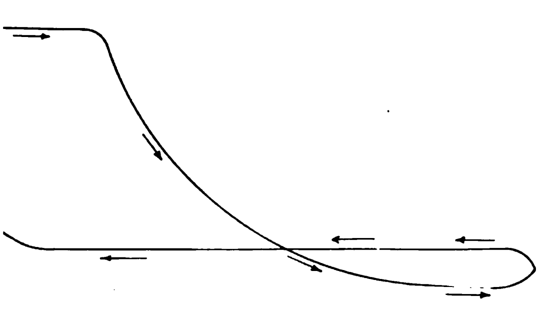
e planimeter should always move in the same ion as that in which the hands of a watch run. starting point for beginning tracing may be on ortion of the line, but it is a good idea to start beginning of the steam line, as follows: Place tracing point on a pencil line, taking the



IG. 3. AN ENLARGED VIEW OF THE DIVISIONS.

g of the instrument as it stands, then with the g point following the line of the diagram in the ion in which the hands of a watch move, followe lines as they were made by the indicator pencil. s important that the tracing does not become re- d when measuring loops which occur on the up- nd lower parts of the diagram in some cases. If ver, the loop is what is termed negative or such curs when the expansion is below the atmos- , it must, of course, be subtracted from the other n of the diagram in order to get the mean effec- ressure. It will be seen that by following the f the diagram as directed, the point will pass d the negative portion of the diagram in a di- n contrary to that of the hands of a watch and his area will be automatically subtracted. This wn in Fig. 4.

ving traced around the diagram and brought the



SHOWING DIRECTION THE TRACING POINT SHOULD MOVE ON A CARD.

r around to the mark from which it started, take ading in the new position, and subtract from it the us reading and the difference will be the area in agram, Fig. 4. It is preferable with a beginner, ver, to place the roller at zero to start with and he reading will give the area at once. But it is fter the instrument has become familiar to take it stands and subtract the initial reading. Sup- the operation is started with the wheel at 1.32 fter tracing the diagram it is found to be 4.63, then the area will be 4.63 — 1.32 = 3.31 square inches. Dividing this area by the extreme length of the diagram, the average height is found.

When two diagrams are taken on one card. it is important that the extremities of both diagrams are not measured at once, but each diagram should be measured by itself. Another precaution against error is to trace the diagram three times, until we have three readings of say, 3.31, 3.32, 3.33, making an average of 3.32, which will be correct. A planimeter of the form shown in Fig. 1 will easily read up to 10 square inches, which is sufficiently large for all indicator diagrams. If, however, a larger diagram is to be measured another form would necessarily have to be used.

The ordinate having been found, is multiplied by the number of spring used in taking the diagram, which will give the mean effective pressure. The remainder of the calculation in finding the horsepower is the same as described in the last article. The rule, however, is as follows: Find the mean effective pressure by any of the methods given, multiply this by the area of the piston in square inches. Multiply this result by the length of stroke in feet, and the product by the number of strokes per minute. This final product divided by 33,000 will be the horsepower of the engine.

The Willis planimeter reads the mean effective pressure direct from indicator diagrams, gives areas of regular or irregular circles or diagrams in square inches, feet and yards without any computation. This instrument is shown in Fig. 5, also its position relative to an indicator card in the process of being traced.

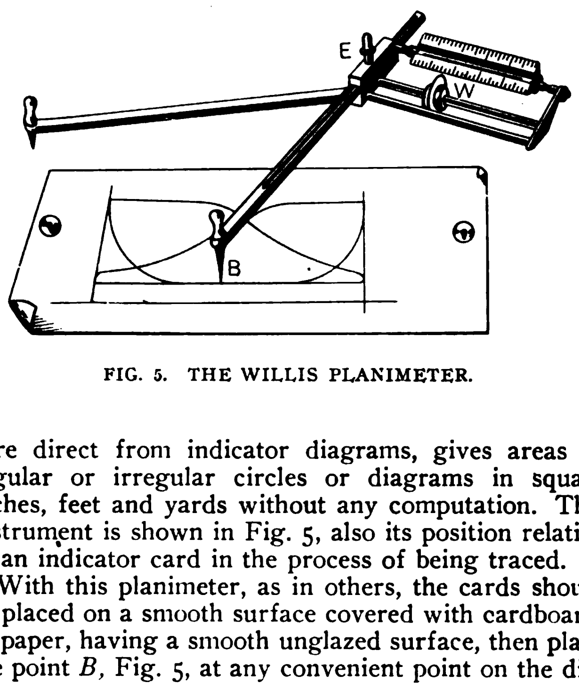


FIG. 5. THE WILLIS PLANIMETER.

With this planimeter, as in others, the cards should be placed on a smooth surface covered with cardboard, or paper, having a smooth unglazed surface, then place the point *B*, Fig. 5, at any convenient point on the diagram, say about the middle of the area to be measured, and set the other point off at about right angles to *B*. Then move *B* to the upper left hand corner of the diagram, and with the left hand move the other arm either to the right or left until the wheel comes to the zero of the scale. Then press firmly into the paper and go around the figure to the right with the point *B*, finishing exactly at the starting point, and then read the instrument.

In measuring large areas watchfulness should be used, because the wheel may come to the end of its travel before *B* has returned to its starting point which will cause *B* to scrape along the paper and destroy the value of the reading. If the operator starts at the upper left hand corner this will generally be prevented, but if it is not the figure will have to be divided into two areas and be measured separately and their sum taken. With the ordinary indicator diagram, however, this trouble will not be found.

The method used for computing the mean effective pressure is shown in Fig. 6. Before beginning, the scale should be turned next to the wheel which corresponds to the spring with which the indicator card is taken. For instance, if a 60 spring were used in the indicator, the 60 scale should be used on the planimeter. Then set the points *A* and *B* to the length of the card, as shown in Fig. 6, and clamp the screw *E*, after which set the wheel at zero and trace around the card to the right. The reading on the scale, when the outline has been traced will give the mean effective pressure in pounds. Tenths of pounds can be estimated by the eye. It is advisable to trace the diagram three times and obtain a mean reading by adding the three results together and dividing by three. This will be the correct reading.

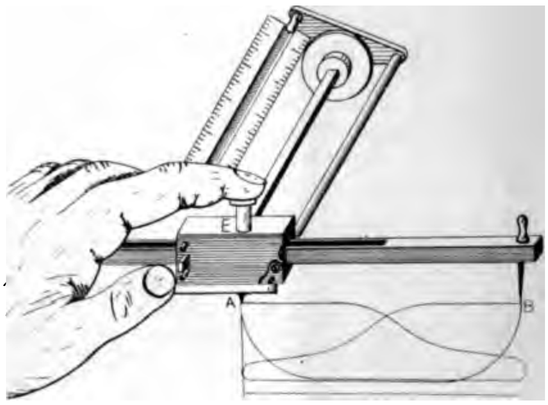


FIG. 6. METHOD OF USING THE WILLIS PLANIMETER.

With short cards, say 3 inches and under, it is not advisable to try to handle the instruments with so short an arm, but to set the pins *A* and *B* to twice the length and go over the card twice. When the decimal figures of the mean effective pressure are required, go over the card several times without stopping the tracing point *B*, and divide the reading by the number of times of tracing. With the usual double card the average mean effective pressure of the two cards can be obtained by setting the point *A* and *B* to twice the card's length and starting at the point of intersection of the expansion curves and going over first one card and then another without removing the tracer.

The accuracy of this instrument is not affected by the wheel climbing up on top of the card, and the same scale which is next to the wheel, can be used for setting off boiler pressures, vacuum lines, etc.

A gallon of water, U. S. standard, weighs 8 1-3 pounds, and contains 231 cubic inches.

A cubic foot of water weighs 62.425 pounds and contains 1,728 cubic inches, or 7½ gallons.

CONCRETE FOR ENGINE FOUNDATIONS.

BY JOHN H. RYAN.

Concrete foundations have been used on large engineering works, such as bridges and dams, for so long a time that observations of time effect have demonstrated, that when properly made they will resist all destructive influences better than anything else. Engineers are awakening to this fact and concrete engine foundations are becoming the rule instead of the exception.

There are a number of mixtures which are called concretes, but for engine foundations, crushed stone, gravel, sand and cement are the only components which should be used. The stone should be clean, hard and durable and in size should not be larger than will pass through a 3-inch ring, and for very particular work the stone should be smaller, say such as will pass through a 2 or 2½-inch mesh. The sand should be sharp, coarse and clean, and the cement should be carefully selected after a study of the conditions.

A first-class concrete can be made of crushed limestone if it is tough, sound and clean, and crushed and screened through a 2½-inch mesh, but the limestone should not contain more than 1 per cent of dirt or clayey matter, nor more than 5 per cent of rotten limestone, which you can crush between your fingers. Crushed limestone for concrete should not contain more than 20 per cent of fine stone, which will pass through a ½-inch mesh. Clean gravel makes a good substitute for crushed stone when used in the proportions of one part gravel and one part crushed stone. Very good concretes have been made by using sand and gravel just as it comes from the pit, that is, by using it from 30-mesh sand up to 2½-inch gravel, but the using of such mixtures is not advisable, unless the engineer has made some study of the filling of voids. If the sand and gravel is mostly small there will be an excess of small stuff for filling the vacant spaces between the larger pieces, while to properly cover all the surfaces of the fine sand with cement will require more cement than is necessary with a proper mixture of sizes. If the large sized pieces are in the majority, the concrete may be full of holes.

The study of voids in concrete materials is simple and interesting. Take any water tight measure that is convenient and fill it even with crushed stone or other material. To conform to actual conditions the stone should be wet before it is put into the measure. When the measure is full of stone, pour in as much water as the measure will hold without overflowing. Then on measuring the water, you will have the amount of sand and cement required to fill the voids in stone of the size just measured.

Crushed granite makes the best concrete, other things being equal. It can be used in different sizes the same as sand and gravel, that is, the fine crushed stone is used in place of sand, and a study of the voids in the size stone at hand and a proper mixture will save greatly in cement. Crushed granite, in fact all concrete material, should be so free from dirt that the handling of it will not soil the hands. Where the stone and sand picks up most of the dirt is during the time in which it is stored and handled on the job. It is nothing unusual to see piles of sand and crushed stone lying on top of the clay that has been dug out to get the foundation on a solid bed. That is not right. The e and sand should be placed on clean floors or beds re there is no possibility of dirt falling or being wn into it.

here are several cements used in making concrete. uine Portland cement is made by heating lime and ey matter until they melt and run together and the luct is then ground into fine powder with which are all familiar. A good Portland cement is so fine over 90 per cent of it will pass through a mesh of 00 openings per square inch. For ordinary work ortland cement should be used that will have its al set in three-quarters of an hour and its final set o hours, but if a quick setting cement is desired it be compounded so that it will have its initial set o minutes and its final set in an hour.

. cement is considered as having its initial set when ill bear, without being appreciably indented, a wire of an inch in diameter and loaded to weigh ¼ of ound, and a cement has acquired its final set when ill bear a wire 1-24-inch in diameter loaded to a nd. A quick setting cement is never as strong as ow setting one on account of the soda or other lterating material which is used to regulate the of setting, and a quick setting cement, if stored any length of time, will lose its quick setting prop-s and become a slow setting one of inferior quali-on account of the adulterating material which it ains.

osendale or natural cement is made by ting natural rock at a heat below the fusion or ing point and then grinding the product to powder. grade of cement that is frequently labeled Port-l, and sold as such, is the so-called slag cement, but proper name for this is Puzzolan cement. It is le by mechanically mixing and grinding together t furnace slag and slaked lime. But the lime and raulic base are not fused as in the manufacture of ue Portland cement. The name slag cement does properly designate this cement because the Port-l cements are now also made from blast furnace . Puzzolan cement is much lighter than Portland, specific gravity being from 2.6 to 2.8, while Port-l cement has a specific gravity of from 3 to 3.5. ess it is treated with soda the Puzzolan sets much er than Portland cement does.

. concrete made from Puzzolan cement very nearly as strong as if Portland used and for some locations it is better Portland because it never sets real hard and is efore tougher and not as brittle. It is well fitted foundations which will always be damp or for any erground work, but it is unfit for use where it will ubject to mechanical wear or where it will be ex-d to the air, because its sulphides will oxidize and surface will shrink, crack and turn white. On ac-nt of its toughness it is advisable to use Puzzolan ent for the interior of engine foundations, and to the air from it, a 1½-inch casing of Portland ce-t mortar should be built around the concrete er.

ilica cement is merely a Portland cement mixed sand and then reground. To be exact it should alled a mortar. On account of the very thorough ture of the sand and cement during the regrinding, lica cement is excellent for grouting purposes, such he bed plates and outboard bearings, or where a dation is being made out of all sizes of stone in-d of solid brick work.

Concrete, using Rosendale cement as a binder, for ordinary use is made by measure as follows: One part of cement, two parts sand and five parts crushed stone. If a stronger concrete is desired the proportions can be one part cement, two parts sand and four parts crushed stone.

Portland or Puzzolan cement concrete for ordinary use is proportioned, one part of cement, 2½ sand and six crushed stone. Whenever a stronger concrete is desired the sand and stone proportions may be reduced to one of cement, two of sand and five of crushed stone. A very strong concrete can be made of one part of Portland cement, two parts of fine granite screenings and three parts of coarser granite screenings. The larger screenings all to pass through a ¾-inch mesh.

All concrete should be mixed on substantial platforms and if they are made of wood care should be taken to see that they are perfectly water tight, because the best and finest of the cement will run out with the water. The platforms or beds should be placed in a position where foreign matter will not get into the concrete during the handling or mixing of the materials and concrete should not be mixed in batches larger than a cubic yard. A simple way of measuring the proper proportions of concrete materials is to use headless and bottomless barrels, or three different sized box frames, one for sand, one for stone and one for cement. The boxes or barrels can be put on the platform and filled with material and levelled off, the frames or barrels can then be lifted out of the way. The measuring of concrete materials in the ordinary round bottomed wheelbarrow does not give proper proportions.

The order of mixing concrete should be about as follows: The proper amount of sand for one batch is spread on the mixing bed and then the cement proportion is evenly spread over the sand. The sand and cement are turned over dry until they are thoroughly mixed and then they are wetted and mixed into a rather thin mortar. In wetting cement mortar it is advisable to use a spray instead of pails or a jet. The thin mortar is then spread out on the bed and the proportion of crushed stone is spread over the mortar. The stone should be washed or thoroughly wet down before it is added to the mortar, so that the stone will not absorb the moisture from the mortar. The whole mass should be turned over at least twice so as to thoroughly coat the stone with mortar. As soon as the concrete is mixed it should be dumped into the mold so the cement will have its initial set in place. Cement which has become hard and which is softened up by mixing with water is not as strong as lime and this should not be allowed to happen. The concrete should be of such a consistency that it will almost hold its shape in the wheelbarrow or just wet enough so that when it is properly tamped the water will flush to the surface.

All concrete should be placed in molds and if the concrete is going to be in view the mold should be built of planks that are planed on one side and both edges. The planks, when finished, should not be less than 1¾-inches in thickness and should be tied together and stiffened so that the concrete will not yield during filling and ramming. Four feet is about the limit for distance between studs or tie braces. Concrete should not be made with sharp corners and fillets should be placed in the molds at all sharp angles. No corner should be sharper than 2 inches, and if stone larger than 2 inches is used the corner should be as wide as the largest stone. Molds should not be removed for at least two days after the last concrete is put in. Before the concrete is put in, the molds should be wet down on the inside. This will prevent the wood of the mold from absorbing water from the concrete next the planks. The chemical action between the cement and water can then take place. The absorbtion or evaporation of the water before chemical action takes place accounts for the crumbling of the outside of mortar which is strong in the interior of the wall. When concrete is being dumped in molds, men should be put to ramming the concrete in the mold so that the mortar will fill all voids between the stone. Nine inches is about as thick as it is possible to ram properly and if there is not enough concrete mixed to fill out a layer in the mold a plank should be put across the mold and the layer tamped up square instead of sloping down. If the concrete is allowed to slope, the slope will not ram properly and when the next layer of concrete is put in it does not join chemically with the under layer and there will be a tendency for the upper concrete to slip on the slope.

Concrete which is exposed to air and weather should have a Portland cement mortar finish on the outside. This finish can be put on when the mold is removed, but a better way is to put on the facing as the concrete is built up in the mold. If a concrete foundation is faced off in this way, it is then possible to use Puzzolan cement for mixing the concrete, thus making a very reliable job.

The manner in which a mortar facing may be put on when filling the mold is as follows: Take a piece of sheet iron, say 6 feet long and 10 inches wide, bend up 1½-inch of the ends at right angles and set the plate in the concrete with the bent up ends touching the the proportion of one of cement to two of sand, and tamp the mortar in with a trowel or shovel. Then fill in the concrete. When the concrete is as high as the mortar the sheet iron can be removed and the concrete tamped. The mortar should be stiff so that the stones will not penetrate to the mold when being tamped. The mortar facing and the concrete center being carried up together make a monolith of the whole. When the concrete is completed the top should be faced the same as the sides and then covered with old bagging or the like, which should be kept damp for a few days or until the cement has had time to set properly. The engines should not be put on the foundation for at least a month. When an engine is bolted to a well-made concrete foundation it has to stay there and can not go meandering around the room.

Four Killed in Flywheel Explosion.

Four men were killed and three others seriously injured by the bursting of a flywheel at the National Tube Co., McKeesport, Pa., recently.

The explosion occurred in the afternoon while over 400 men were at work in the mill. The wheel was 25 feet in diameter, and went to pieces with a loud report, tearing a big hole in the side of the mill and wrecking thousands of dollars' worth of machinery.

About a year ago a flywheel exploded in the same department, killing a number of men.

THE IDEA·EXCHANGE

Connecting-rod Brasses.

Editor of the Engineers' Review:

It has been with some amusement that I have read the controversy between some of your readers, as to the effect of keying up brasses on the connecting-rod of steam engines. Some call it hash, others think it is twaddle and others think there is a good deal in the question. As there seems to be a difference of opinion as to just what takes place when keying up, and as there are so many different kinds of brasses and ways of tightening them, I have submitted illustrations of some of the most common ways of arranging the brasses in the connecting-rod, and the way in which they are adjusted.

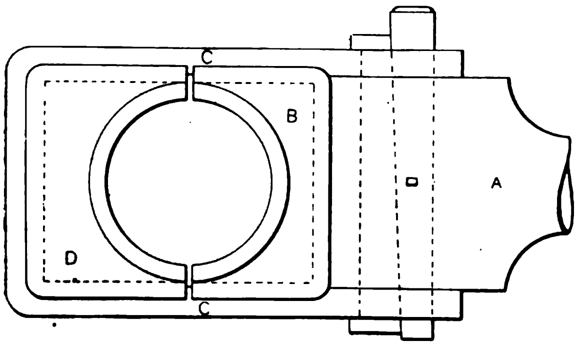


FIG. 1. BRASSES, STRAP, KEY AND GIB.

The methods of constructing connecting-rods are so different that for a basis to work from, it is as well to begin with the old fashioned type, as it is called. If it were not for the wear of the wrist and crankpins of an engine, it would be possible to make a crank-rod of one piece, providing also it did not wear, but such a condition is out of the question, and for that reason the crank is provided with brasses which are so arranged that they can be taken up as they and the pins wear.

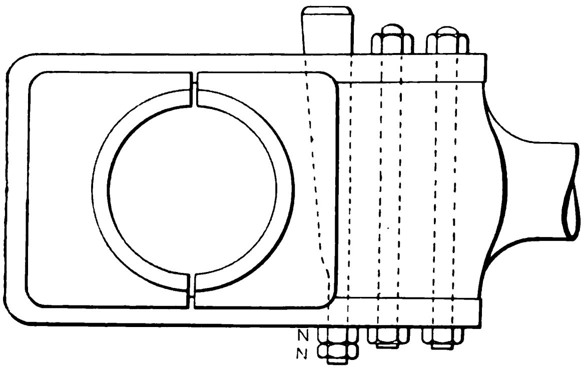


FIG. 2. A STRAP HAVING NO GIB.

With the type of brasses and connecting-rod shown in Fig. 1, the brasses are split and held against the end of the steel rod by means of a strap, and secured with a gib, a key and a set screw. As shown, the connecting-rod is designated by *A*, and is perforated at each end so that the gib and key may pass through the stub end, which butts up against the brass *B*. The strap *C*, *C*, holds the brasses *D*, and *B*, in place. The strap is perforated for the passage of the gib and key, the perforation being the same size as the perforation in the connecting-rod, but they do not correspond. Into these perforations the gib is first placed as shown, so that the nose rests upon the strap, in order to prevent the gib from falling out of the hole. When the key is inserted and driven in, the two sections of the boxes are forced together until the proper amount of tightness is secured. When the brasses are fitted to the pins as desired the key is held in place by means of the set screw. The space between the sections of brasses should be filled up with liners.

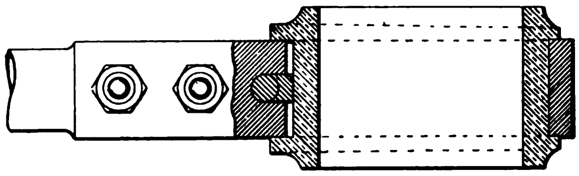


FIG. 3. SECTIONAL VIEW OF FIG. 2.

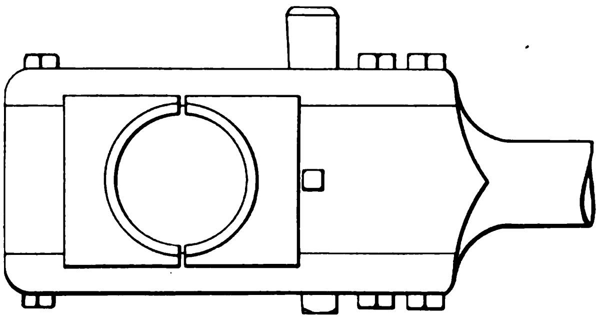


FIG. 4. STRAP MADE IN FOUR PIECES.

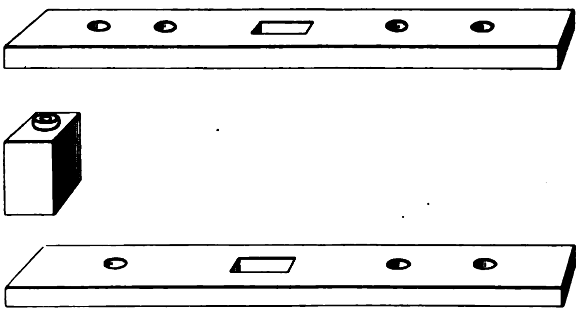


FIG. 5. THREE SECTIONS OF THE FOUR PIECE STRAP.

Another type of connecting-rod and brasses is shown in Figs. 2 and 3, the latter being a sectional view looking up from the bottom. As will be seen from Fig. 2, the strap is the same as shown in Fig. 1, with the exception that the slot is made only large enough for the key, there being no gib used when adjusting the brasses, the key being held in place after adjustment by means of the two nuts *N*, *N*. The butt end of the connecting-rod is drilled for the two bolts which pass through corresponding holes in the strap, and is held in place by two nuts as shown.

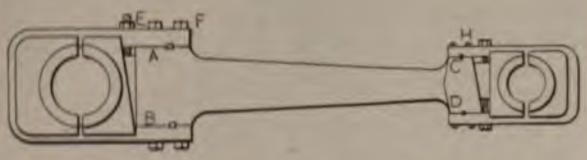


FIG. 6. WEDGE PLACED ON THE INSIDE OF THE BOLTS.

Another type of connecting rod and strap is shown in Fig. 4, in which the strap is the special feature, otherwise it is a plain strap-joint rod in all respects. The adjusting of the brasses is accomplished by means of a key, no gib being used, the brass being tapered to correspond with the taper on the key. The key is held in position by means of an ordinary set screw. It has been found in connecting-rod straps that the square bend in the forging is always the weak part. To avoid this common weakness, this strap, as shown in Fig. 5 has been designed and is built up of four pieces, the sides, end and through-going bolt. In this design of strap, the tenons in the end pieces have a shearing strength equal to the tensile strength of the sides. The tenons are fitted into counterbores in the sides and are supposed to take all the strain, while the through-going bolt only holds the parts in place. This type of strap is considered by many to be an admirable piece of mechanical work and of great strength.

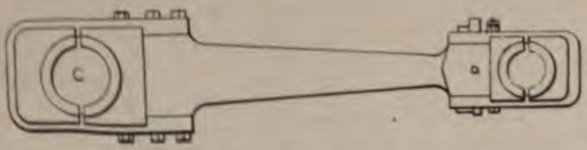


FIG. 7. A CONVENIENT FORM OF ADJUSTMENT.

Fig. 6 shows a connecting-rod, the adjustment of the boxes being by means of a set screw attached to a wedge key, by means of which the wedge is lifted or lowered. As shown in the figure the taper of the wedge and that of the brasses give a large and uniform bearing against each other and as the wedges are placed inside of the pin on either end, the length of the rod remains the same when keying up for lost motion, providing each brass wears away at the same rate. In

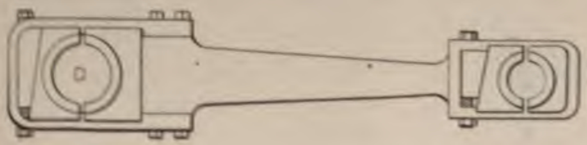


FIG. 8. COMBINATION OF REGULAR STRAP AND SOLID-END ROD.

Fig. 9 shows a type of rod similar to Fig. 8, with the exception that there is a slight difference in the shape of the brasses, the taper not extending down as in the ordinary case. On the crosshead end *H*, the outer brass is rounding, as is also the end of the rod. There is one objection to this feature as in some instances such a brass will have a tendency to turn which will cause a knocking in the brasses.

Fig. 10 shows another type of connecting-rod with strap adjusting wedges, etc., which is similar to those preceding with the exception that the wedges in the crank end taper against the brass, while on the wrist-pin end the taper is against the rod.

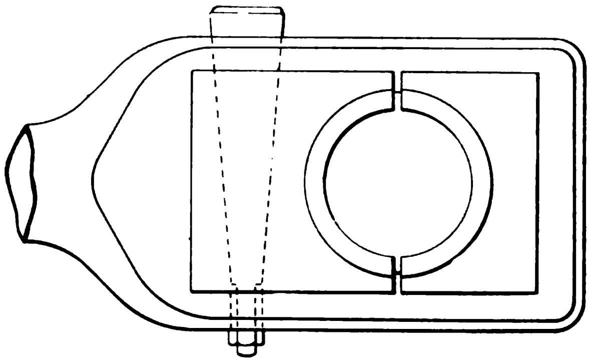


FIG. 12. BRASSES ADJUSTED BY A TAPER WEDGE.

The connecting-rod shown in Fig. 11 is of the marine type. The box part as well as the strap is securely bolted to the connecting-rod end, the box being fitted into the strap and is adjusted by means of a wedge and bolt, giving a quick and positive adjustment. The other end of the rod shows the brasses to be adjusted by means of a taper wedge, passing through the rod sidewise.

In Fig. 12 is shown a type of connecting-rod which might be called standard, wherein the adjusting wedges of the boxes are placed, one inside and one outside of the pin, in order, as has already been stated, to equalize the wear of the boxes and prevent the lengthening of the connecting-rod, as would be the case if both wedges for adjustment were placed inside. It will be noticed that the adjusting key passes entirely through the rod and is held in place by means of the nut.

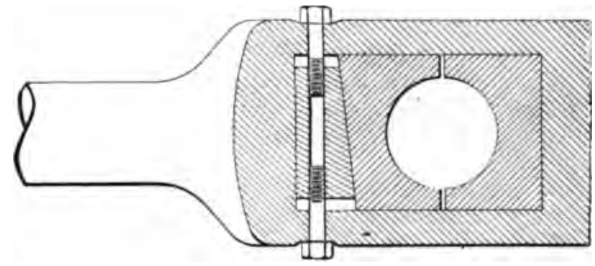


FIG. 13. SOLID-END ROD WITH TWO BOLT ADJUSTMENT.

Another type similar to this is shown in Fig. 13, with the exception that in this instance the adjustment is made by means of two bolts in which one adjusts the wedge and the other holds the adjustment in place. Whether this adjustment is made from the top or bottom depends to a great extent on the ideas of the builder.

The connecting-rod shown in Fig. 14 is made with solid ends slotted out square. The boxes are fitted snugly in these spaces, and are adjusted by means of wedges placed horizontally in the ends of the rod. The adjustment of the wedges is rendered easily accessible, especially so at the crosshead end. The wedges are so constructed that they rest on the boxes the full width and depth and are operated by means of a screw bolt which allows of a very fine adjustment. A small set screw underneath the rod is added as a safety check. In this type of rod the design is such, that the taking up for adjustment will leave the distance from center to center of the pins constant.

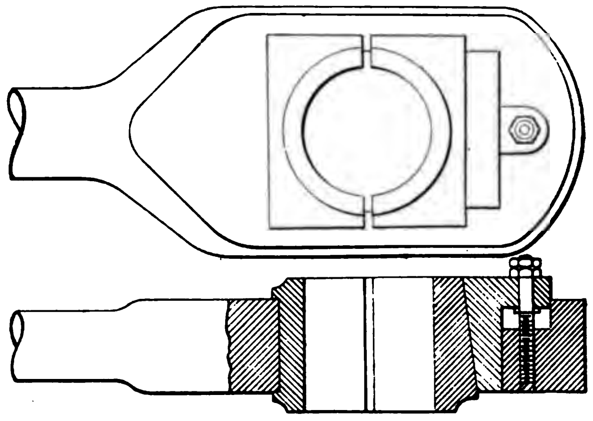


FIG. 14. SIDE ADJUSTMENT OF BRASSES.

The connecting-rod shown in Fig. 15 is worthy of attention as an improved means for taking up lost motion has been adopted. It has been found that by filing away a certain amount of the top and bottom of the ordinary brasses that better lubrication has been obtained and that wider space can be left between the brasses to allow for keying up without again having to file them at this point. In the rod shown in Fig. 15 even after considerable wear, the form is still the same as that shown in the illustration, and without the necessity of filing the brasses at all. This adjustment is made by means of the tapered wedge as shown.

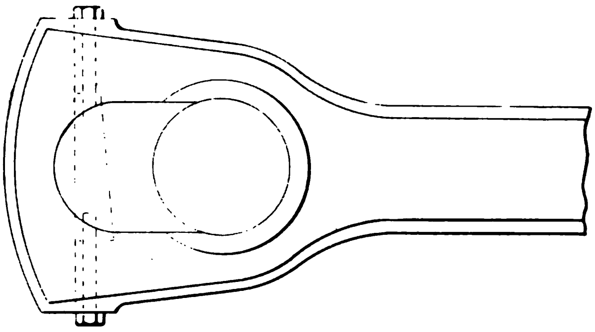


FIG. 15. A FORM OF BRASSES WHICH ALWAYS REMAINS THE SAME.

Fig. 16 shows a connecting-rod which is made solid, the ends being afterwards drilled and slotted out to receive the boxes. In this type of rod the wristpin box is adjusted with an improved wedge adjustment as shown at *W*, *W*, while the crankpin boxes are adjusted by the ordinary type of wedge-block and bolt.

There are numerous other types and designs of brasses, but an examination of all of them shows that the principle of construction and operation is practically the same as those already given.

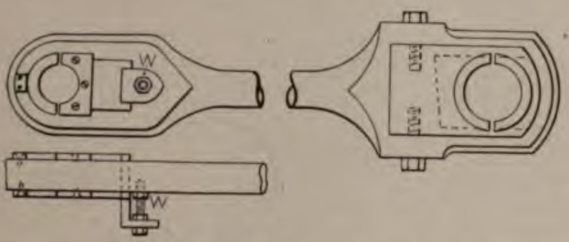


FIG. 16. AN IMPROVED WRISTPIN ADJUSTMENT.

It will be seen that in the majority of types herein illustrated, the keying up of the brasses does not change the clearance of the piston in the cylinder, therefore, the length of the rod is not changed as is the case with some types of connecting-rod.

M. T. Picands.

Observation.

Editor of the Engineers' Review:

I work at night and when I got home in the morning after a hard night's sleeping in a chair, the lady of the house said, "Jack, take the baby out for a while, so I can do my work." My remarks about there being no rest in this house received no attention and the kid with his newly washed face and wet bangs was thrust into my arms. I tried to kill two birds with one stone and proposed to the baby that we go down to Baker's Chocolate Mills to see the "wheels go round."

We spied the engineer of the Webb mill standing in the doorway of the engine room and went over and scraped up an acquaintance with him. After we told each other of the good and bad qualities of other engineers with whom we are mutually acquainted, I sprang that ancient joke about the builders of the Putnam engines putting enough iron in the frame of their engines to make an extra flywheel or two.

That started him talking about the pair of old Putnams that he is running. He gave it as his honest opinion that they are as well built and as economical in the use of steam as any later type of engine of the same size working under equal conditions. In proof of his assertion he brought out a bunch of indicator cards. They were held together at one end with a large safety pin which was passed through them at right angles to the paper. This was a new one on me and I consider it a very convenient way of holding indicator cards for it is a vast improvement over the ordinary way of keeping them loose in a box or drawer.

There were about 75 cards in the lot which had been taken at monthly intervals during the six years that he had been operating the plant. They told quite an interesting story. One could see by them how the load varied at different seasons of the year, and how the cylinders were gradually wearing with the consequent leakage of steam from one side of the piston to the other. The difference in two cards taken a month apart could not be noticed, but comparing cards taken a year apart showed that the later one had all the earmarks of a leaky piston; namely, the expasion line did not hold up as it should, the back pressure was higher and the compression less than it should have been. The first card taken after the cylinder was bored showed the improvement that a tight piston made. But the kernel of this story comes in the changes that were made and the variations that took place in the steam distribution.

The first card taken after he took charge of the plant showed what kind of a job an engineer will do when he has to set the valves of his engine by hand and he cannot get an indicator to correct the minor errors which are sure to be present. In this case the head end setting was perfect, but the crank end did not have lead enough and the crank end exhaust valve did not open until the crank had passed the center. There was also a very small amount of compression on this end. As the engine always received the best care and was always kept well oiled and keyed up, the lack of compression on the crank end could not be noticed when running noncondensing, but with the condenser on, there was always a slight thump, its cause not being suspected.

The next card taken after the valve setting had been corrected was a model card from a Putnam engine. After this for three years the cards were all right with the exception of those taken while the piston was leaking, as already mentioned.

For quite a while after the cylinder was bored out, the cards were alike with the exception of the steam line which naturally varied with the load. Then he came across one and asked me what I should say was the trouble with the engine. I looked the card over and saw that the head end was all right, but the crank end had too much compression. I replied that it looked to me as if some of the mechanism of the crank end exhaust valve had moved and caused the valve to close too soon, thus giving too much compression on that end.

He said, "That is just what our master mechanic said when I showed him the card and he recommended that the adjustment of the exhaust valve be changed, so it would close a little later. I was about to do so when I noticed that everything trammed up all right. This rather pleased me and I looked at the card again. By careful observation I found a good deal wrong with it. Following the card from the beginning, I noticed that the lead on the crank end was correct and the pressure remained constant up to the point of cutoff, then the expansion line did not drop as fast as it did on the head end and consequently the pressure on the crank end was higher when the exhaust valve opened to the condenser. The back pressure line of the crank end just cleared the back pressure line of the head end. Although the back pressure of the crank end was only a fraction of a pound higher than the other end, it remained higher throughout the whole length of the stroke. This was good proof that there was a constant addition of steam to the crank end of the cylinder while the exhaust valve was open and the expansion line remaining high was additional proof that it was a live steam leak instead of a leaky piston; for a leaky piston would have nearly the opposite effect, that is a quick drop of the expansion and a reduced compression line. But the back pressure would be higher as in this case. As the engine had run 20 years it was rather late for dirt to get under the steam valve and hold it open and it was not natural to suppose that one valve would show much more wear than the other in the course of a month."

A little more hard thinking put him right. The Putman engine has separate valves for steam and exhaust but only one port for each end. The steam chest is bolted onto the cylinder and the joint between them is made steam tight with a gasket. He came to the conclusion that a small part of this gasket must have blown out between the cylinder and the partition between the steam and exhaust valves. This leak would then act as a small bypass around the steam valve and thus the crank end of the cylinder was getting steam from the boiler at both strokes. He disconnected the valve gear of the crank end and took off the steam chest and found the gasket blown out as he suspected. After putting in a new gasket the engine was again started up, and the valve adjustment was found to be perfect.

How many engineers would have found out what was the matter with this engine? Would not the most of them do as the chief and I suggested, that is, close the exhaust valve a little later to cut down the compression and let it go at that? Does not the above incident prove that the use of your head in an engine room is a great help? In the above incident there were no external evidences of internal disarrangement, but our friend had trained himself to observe and to think clearly from his observations. John H. Ryan.

Unexpected Breakdowns.

Editor of the Engineers' Review:

Two peculiar breakdowns have recently come to my attention which I think will prove of interest to the readers of the Review.

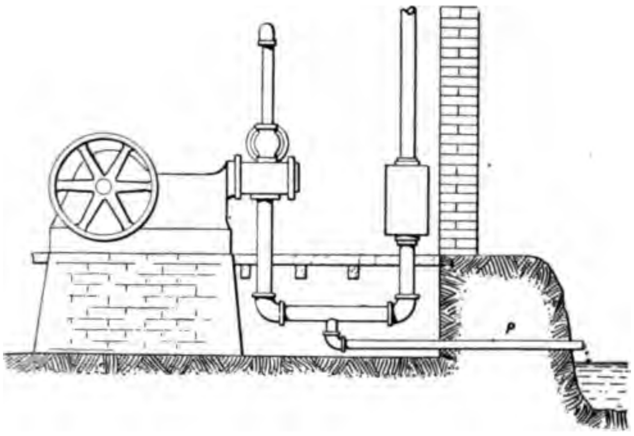


FIG. 1. DRIP FROM THE EXHAUST PIPE.

In the first instance the engine set beside the boilers with the heater located in one corner of the engine room next to the back wall. As shown in the illustration, Fig. 1, the exhaust pipe from the engine cylinder which was of the overhang type, formed a pocket between the cylinder and the heater. In order to drain this pipe, the drip pipe *P* was tapped in and run underground to the bank of a river from which the boiler feed supply was obtained. Frequently, due to excessive rains, the water level of the river would raise a foot or more in height, and occasionally to such a height that the drip pipe *P* would be submerged.

It was during one of these periods of high water that the accident occurred. The engineer had started up his engine with hardly any load on to speak of and as has been assumed by all who investigated the affair, it is probable that the water was pumped in from the river through the pipe *P* to the cylinder of the engine. This was brought about because when the engine had practically no load, the steam would expand to a pressure much below the atmosphere, which would create a partial vacuum in the cylinder when the exhaust valve opened. This repeated enough times soon drew in enough water to cause a first class wreck of the cylinder head, piston and a bent piston-rod. It is needless to say that the drain was immediately changed and high water does not bother that plant any more.

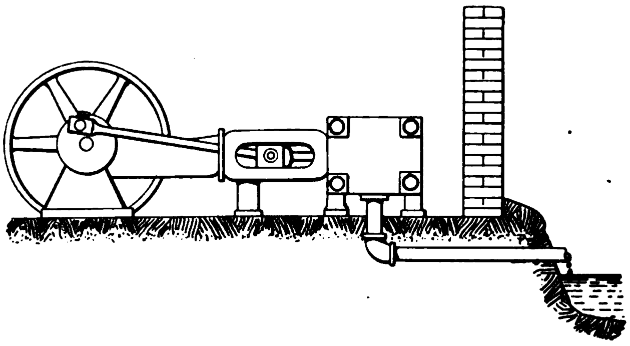


FIG. 2. LOCATION OF THE EXHAUST PIPE.

The other instance is where a four-valve engine was employed in street car service. As there were two engines, only one was used in connection with the heater, although both could be connected if desired, consequently the exhaust from one engine was passing through the heater while the other passed directly to the atmosphere.

In this second instance the exhaust pipe ran underground to the bank of a river which was affected by the rise and fall of the salt water tide. On rare occasions when the wind was in the right direction and blowing a gale the tide would back up to such an extent as to raise the water considerably above its normal level.

In this instance things were moving along as usual with no apparent presence of any agent which might cause a disaster, when suddenly the cylinder head was knocked out, the crosshead broke and the piston sprung. Apparently the same cause as in the first instance was responsible for the trouble.

The load on street railway service being fluctuating, the engine was suddenly relieved of its load through the larger number of cars being stopped at once, when the steam expanded down below atmospheric pressure and a partial vacuum formed in the cylinder. Anyway the water was drawn up into the cylinder with disastrous results. These two instances go to show that it is a safe thing to have all engine drips and exhaust pipes exposed to the air several feet above any possible water level. C. H. Nove.

Leaky Oil Cans.

Editor of the Engineers' Review:

The innocent leaky little oil can of the shop, the mill and the engine room, has been the direct or the indirect cause of fires in very many cases. Sometimes the fire arising from the leaky oil can does not develop for some years. In one case of a mill fire, the oil can had dripped oil for months. Finally the can was renewed, but the oil drippings remained and the cluster of dust, wastage, etc., in an obscure corner eventually heated, with the result that almost a year after, spontaneous combustion caused a fire that did considerable damage.

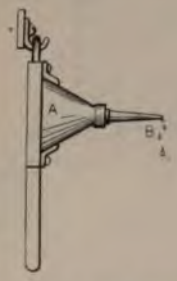


FIG. 1. OIL CAN HUNG ON A STICK.

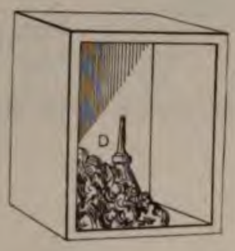


FIG. 2. CAN AND WASTE.

In another workshop it was the practice for the oiler to hang his oil can and stick up on a hook on the wall as represented in Fig. 1. The oil can *A*, was secured to a stick for convenience in oiling the overhead shaft journals. Rather than remove and replace the oil can each time, the oiler would hang it up, as shown, in a vertical position, so that the nozzle *B* dripped oil until the oil supply became exhausted, causing the woodwork of the floor to become oil soaked. One day a lighted pipe was left in a pair of overalls on the floor, which caught fire and the flame spreading to the floor and the oil-soaked timber made a blaze that was extinguished with difficulty.

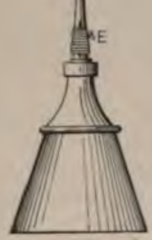


FIG. 3. CRACKED SPOUT.

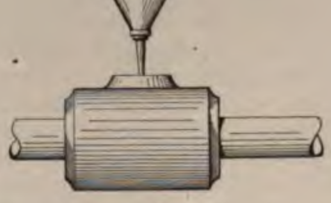


FIG. 4. A CRUDE OILING DEVICE.

Fig. 2, is a dangerous plan which consists of nailing a common wood box to the wall, and keeping the oil can therein, with the usual quantity of cotton waste for wiping purposes, as at *D*. Frequently we learn of fires starting from heated waste. Sometimes these boxes are abandoned and the workmen forget to remove the waste and a fire from spontaneous combustion is the result.

A leaky oil can as shown in Fig. 3, will be recognized by many. Oil cans, after they are split as at *E*, ought to be repaired or discarded. But they are often seen wound, as shown, with string in hope of partly checking the leakage. It is a poor plan as oil is sure to leak through.

One of the most absurd displays of "put off until tomorrow," is shown in Fig. 4. The workmen in their attempts to stop the squeaking of a troublesome journal, adopted the plan of adjusting an oil can upside down in the oil hole, so that the oil self-fed to the bearing through the nozzle. The oil had flooded the bearing, the shaft and the flooring and parts below. The can had to be renewed every morning. This method was carried out although the binding and disordered parts heated to the extent that the dripping oil would burn the hand. The bearing was finally taken apart, trued, cleaned and the parts correctly reset, doing away with the binding, after which the usual supply of lubricant answered all purposes.

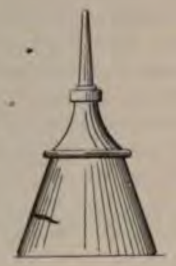


FIG. 5. CRACKED OIL CAN.

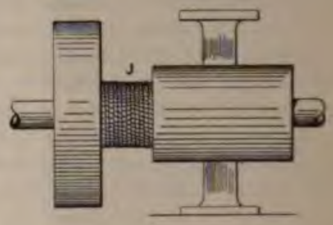


FIG. 6. SHAFT WOUND WITH HEMP ROPE.

The cracked oil can shown in Fig. 5, can be located in actual service in mills and shops every now and then. The crack was not expanded sufficiently to cause the oil to escape in any large quantities, but permitted the oil to slowly ooze forth.

In a flour mill the machinist had wound a shaft near a box bearing with hemp rope as at *J*, Fig. 6, and this rope he kept saturated with oil. The idea was to convey oil uniformly to the bearing. But the machinist forgot about friction and heat generation. This rope was already charred due to frictional heat.

Traveler.

Driving Up Bags.

Editor of the Engineers' Review:

The question of driving back bulged sheets on boilers is a matter which has been rarely discussed in the mechanical journals, says Mr. Lyman in a recent issue of the Review, and Mr. Lyman would like to have the discussion opened. Bulges are the result of overheating of the metal resulting from deposit, etc. collecting on the inner surface, thereby preventing water from coming in contact with the plate. Being directly subject to the impingment of the hot gases, and with the steam pressure tending outward, the plate which has become granular, bulges.

I have inspected boilers in about 21 states during the last eight years, and it has been my lot to pass judgment on hundreds of boilers affected with bulged sheets and the advocacy of "driving back" depended entirely upon the circumstances under which the boilers are to be operated. Boiler inspectors as a rule, are adverse to this form of repairs, and only advocate so doing as a temporary means, and when resorted to, it requires the services of skilled workmen. If performed otherwise, it is ten to one the operation will prove a failure.

The method usually employed in forcing back a bulge is to first procure an improvised furnace the exact size of the bulge or bag. This furnace can be made of a piece of old sheet iron, and made so as to conform to the circle of the boiler, leaving an opening on one side for supplying fuel and draft, after which a pedestal of some sort may be erected for the purpose of keeping the furnace up tight under the bulged plate. This pedestal should not be built too rigid, because when the proper heat is attained, the furnace and pedestal both must be thrown quickly to one side, in order to strike the iron while it is hot.

After the workman is assured that he has his furnace in good working order, his next thought must be to provide a suitable kind of fuel. Wood coke has given the best results, although dry pine wood has given good satisfaction. The furnace is filled with the fuel decided on. If the plant is fortunate enough to be provided with an air compressor, an air attachment can be made and connected to the furnace by means of a hose, but in the absence of air, an ordinary bellows may be used with equally good results, although the heat in the latter case will not be so rapid. When this improvised furnace is in successful operation, and the bulged plate becomes red hot some coke or wood should be placed on the inside of the bulge, as this not only intensifies the heat, but also tends to give considerable lift to the injured plate, thereby aiding the drawing back process.

When the plate has attained a white heat the furnace should be quickly removed and an 8-pound sledge in the hands of a skilled workman used in driving back a bag of ordinary dimensions with one heat. All bulges should be driven back with the aid of a flat piece of iron, as striking on the hot plate with the sledge invariably makes undesirable dents, and likewise makes a poor looking job when completed. The bulge should also be put back so that the inner surface will be slightly convex in form, as this tends to strengthen the defect, as well as averting the danger of mud pockets.

Bulges driven back in this manner, have within my experience been known to last without evidence of failure the natural life of the boiler, but as previously stated, there is nothing reliable about the procedure, and I would not under any circumstances advise drawing back bulges of large proportions.

It has been found to be both practical as well as economical, to say nothing of mechanical, to substitute a new sheet, as patches are too undesirable, especially where the patches come directly over the fire.

As a means of preventing bulged sheets I advocate low grate bars, low bridgewalls, clean combustion chambers, and last, but not least, clean boilers.

It is the duty of the inspector to report the condition of things exactly as he finds them, and I can assure the reader that there is nothing that he hates to do more than have to report needless and careless defects of the steam boiler and its immediate attachments.

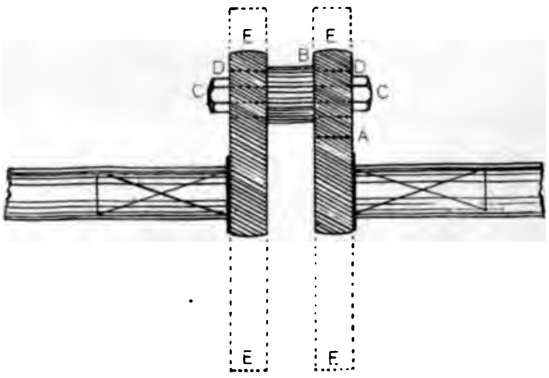
Inspector.

Temporary Crankpin Repairs.

Editor of the Engineers' Review:

A number of years ago the writer made numerous visits to an electric lighting plant in a city of about 5,000 inhabitants. The electric lighting company had a contract with the city for street lighting, and the city being a growing town kept adding more lights until the dynamos and engines were carrying all they could stand. The light company operated two large saw mills and a large planing mill, consequently the fuel consumed under the boilers at the lighting station, did not cost them anything while the planing mill was running as a large exhaust fan blew the shavings direct to the fuel room at the lighting station and at the same time direct to the boilers through automatic feeders. When the planing mill was not running, which was a rare thing, they hauled slabs from the saw mill for fuel, however this was not a very heavy expense. Under these conditions the light company was a complete success, paying large dividends.

Owing to the success thus attained the stockholders were desirous of having their dollars earn still more, and as the building was larger than necessary for what it contained they concluded they had ample space for extra dynamos to be used for commercial lighting. Consequently they started out to get subscribers with this end in view. They had a good man in charge of this work, who was very successful.



MANNER IN WHICH THE CRANK WAS REPAIRED.

Under the flattering success thus attained a new dynamo and engine were contracted for and installed in due time, and the new enterprise started off very smoothly. The subscribers were pleased with the lights and a number of the head men of the city concluded they would embark into a private park plan as the opportunity was now open for an enterprise of this character. The plan was to have a very large hall for public balls and other amusements and also a large opera house, with well laid out grounds. The park was to be laid off with several walks each lined on both sides with electric Japanese lanterns, and so the park company entered into a contract with the electric lighting company to furnish about 3,000, 16-candle power lights.

This put more of a load on the engine and dynamo than they had anticipated. But by being careful they concluded they would try and carry the extra load until a certain time when they intended building a new power station and installing heavier and more powerful machinery. However, these plans did not mature as intended. The engineer noticed one day that the pin in the crank of the self-contained engine was getting loose, and ordered a new crank to be shipped as soon as possible, but the damaged part kept getting worse and had to be stopped. Now as most of their patrons had done away with other means of lighting it became a serious proposition for the light company. Still the engineer was not discouraged as he thought he could repair the crank so they could run with part load and thus not be without light entirely.

The company concluded if the engineer was capable of getting the machinery going for the time being it would be well worth the time and expense trying the experiment; so he went to work removing the crankshaft and taking it to a machine shop had a 3½-inch bolt put through the pin with heavy nuts on each side of the crank, as there was room for the nuts to pass the engine bed casting. After the shaft was repaired it was loaded on to the dray and hauled to the station, replaced and started up, and gave no trouble whatever. In due time the new crank arrived and was installed.

By referring to the illustration, *B* shows where the pin was broken, and *C* shows where the bolt was put through with nuts *DD*, on each end.

During the summer of 1904, while on my way to the plant of an electric light company where I had some business with the engineer, I stopped at a machine shop and in the course of conversation stated I was bound for the electric light plant. They smiled and stated I had better side track myself as they were in a peck of trouble, and visitors were out of order, owing to a loose pin in the crank, which was of the center crank style with a pulley on each side of said crank. The shaft was 8 inches in diameter and I think the pin was the same size.

Upon entering the place I found them in the act of taking the machine apart to repair it. I related to the engineer how I had seen a pin repaired which was used until a new shaft arrived from the factory, and they at once concluded to try the same plan themselves; so they stripped the shaft with the exception of the counter balance disks. After taking it out they concluded to take the counter balances off which were machined to fit the crank and held in place by keys which were a part of the crank. The counter balances had a keyway cut in them to correspond with the key and were then slipped on the crank on each side of the pin and bolted securely in place. By referring to the dotted lines, *E* shows the counter balances in place. This made it almost as strong as though the counter balance and the shaft were a solid forging. To make the shaft and crank lighter to aid handling they concluded to remove the counter balances as they were very heavy. One of them came off quite readily, but the other could not be removed easily. After considerable forcing, however, the counter balance was removed.

Much to the astonishment of all, the crank parted at *A*, as soon as the counter balance was removed from the shaft. Instead of the pin being loose or fractured as the engineer supposed, the crank was
broken, and was held in place by the counter b
ance.

After putting in the new crank it did not run v
long before the straps which held the brasses on
crankpin gave away and knocked the cylinder he
out of the head end of the high and low pressure c
inders.

The fact of the matter is they were trying to
with one engine what would have been a fair load
two. The manager had the pennies so close to
eyes that he could not see the dollars just beyond.

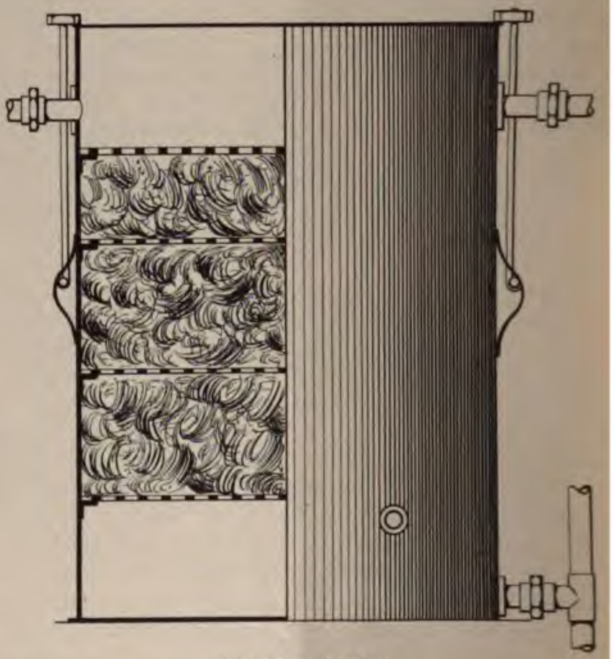
The bookkeeper recently informed me they had p
out enough for repairs and labor to buy a new eng
just like the old one and then have enough left to f
nish a good oyster supper for the whole crew.

W. H. T

Oil Separator.

Editor of the Engineers' Review:

The following is a description of a simple oil s
arator which gave satisfaction in removing oil fr
a heating system. It was placed between the tr
and the return tank and was made as follows: A go



OIL SEPARATOR.

24 x 18-inch ash can was secured and three 1 x ¼-in
angle irons were riveted on the inside 5 inches fro
the bottom. Next the end of a 1¼-inch valve w
pinned and soldered on the inside 1 inch from the bo
tom, and another 4 inches from the top of the can
the outside. Then a 2-inch flange was fastened on t
outside 1½ inches from the top for a vent and to r
lieve any pressure that came.

Four rings of ¼-inch wire were made by brazing t
ends. On these ¼-inch mesh wire screen was fa
tened by winding the end on the ring. Next five stri
of ½x⅛-inch flat wire on which burlap had been fa
tened were formed and pressed tight against the si
to prevent oil passing down. Two ⅜-inch bolts we
made having hooks at one end and fastened to the c

handle, the other to hold the cover on with a washer and nut as shown. The cover is made of 1-inch hardwood with a piece of galvanized tin on the bottom to prevent warping. The cover is grooved for packing to fit tight on the top of the can and is held down by a piece of 1½x⅜-inch steel cut out on ends and placed across the top. The bolts connecting to the handles go in the ends and so hold it in place.

Close nipples and unions are used on the connections so that the separator may be easily taken out. When cleaning, the whole thing is taken to the boiler room and dumped and then replaced and filled as follows: A screen is placed on the lugs, on this a screen spring with burlap, then 5 inches of excelsior, then another screen and burlap to the thickness of ½-inch, then 4 inches of excelsior and burlap and another screen, then crushed coke with waste on top. When the cover is put on and fastened and the unions made up it is unnecessary to give it any more care for another six months. D. F. C.

Single and Double Connected Lubricators.

Editor of the Engineers' Review:

I have noticed recently several communications regarding lubricators in which the single and double connected pipes are mentioned.

The principle upon which both the single and double connected lubricator works is the same, that is, the oil is displaced by the condensed water, a drop at a time. The water as it enters the oil reservoir forces the oil into the steam pipe where it is carried on to the engine.

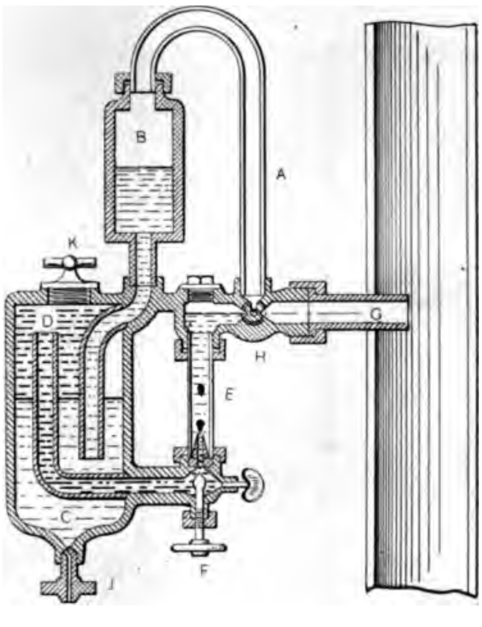


FIG. 1. SECTIONAL VIEW OF SINGLE CONNECTED LUBRICATOR.

Fig. 1 shows a sectional drawing of a single connected lubricator. The steam passes from the steam pipe up through the pipe *A*, into the condensing chamber *B*, and flows down into the oil reservoir *C*, where it will remain at the bottom because the specific gravity of water is greater than that of oil.

The pressure of water in the reservoir *C*, forcing the oil into the steam pipe is due to the head of water in the condensing chamber *B*, and the connections. As this head forces the oil up, it flows through the pipe *D* into the bottom of the sight feed glass *E*. Here the feed is regulated by the needle valve *F*, when the drops pass up through the water in the glass and out through the pipe *G*, to the steam pipe leading to the engine or pump.

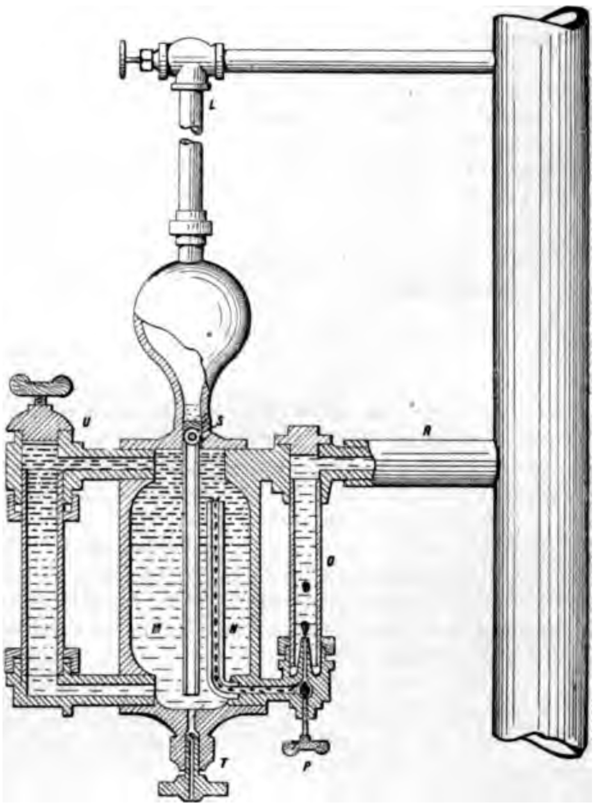


FIG. 2. SECTIONAL VIEW OF DOUBLE CONNECTED LUBRICATOR.

This lubricator is easily filled by closing a valve which is located at *H*, and the valve *F*. Then the drain *J*, is open at the bottom of the reservoir to allow the water to escape, after taking out the plug *K*. When empty of water, close the drain *J*, fill the lubricator with oil and screw in the filling plug *K*. The valve *H* is then opened and then the needle valve *F*, enough to regulate the drops as the engine requires.

With the double connected lubricator shown in Fig. 2, the only real difference is that the condensing chamber is supplied by means of a connection shown at *L*. With this lubricator the condensed steam passes down through the pipe *M*, to the bottom of the reservoir and replaces the oil which is forced down through the pipe, *N* to the bottom of the sight glass *O*, where the drop is regulated in the usual way by the needle valve *P*. The oil will of course rise in the sight glass *O*, and pass on to the steam pipe through the connection *R*.

The way to fill this lubricator is to close a valve which is located at *S*, and the needle valve *P*, and open the drain *T*, at the bottom of the reservoir and then remove the filling plug *U*.

After the reservoir is empty the drain is closed and the reservoir filled with oil and the plug screwed back into place. Then the valve *S*, should be opened and the drop regulated by the needle valve *P*, to the required rate of feeding. Sometimes thick oil will prevent these types of lubricators from feeding freely. In case of failure to give satisfaction, it is an almost sure indication that there is insufficient water in the condensing chamber and reservoir to cause the oil to flow into the pipe leading to the needle valve *F* or *P*.

W. A. Holcomb.

A Homemade Oiling System.

Editor of the Engineers' Review:

For convenience around a steam plant there is nothing that will fit the bill in a more satisfactory manner than an oiling system to supply oil to the engine bearings. My plant consists of a 500-horsepower engine, but the system can be arranged on any engine regardless of the size, the only difference being in the size of the supply tank and piping.

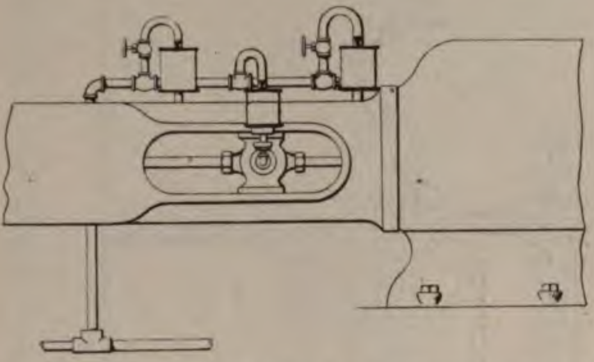


FIG. 1. OILING SYSTEM CONNECTED TO GUIDE AND CROSS-HEAD.

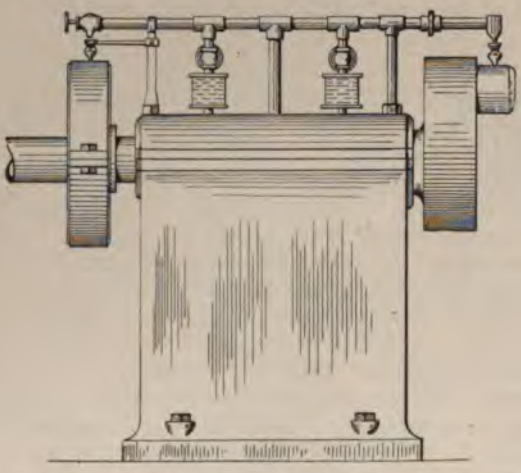


FIG. 2. PIPE CONNECTIONS TO THE BEARINGS, CRANK AND ECCENTRIC.

The oil supply tank is placed about 18 feet above the floor and is supported by two beams having planking across them. The tank will hold 35 gallons of oil, and has a drip in the bottom, to allow for draining, etc. The main pipe is 1¼-inch, and runs to the basement, where it extends along until about midway of the engine frame, as shown in Fig. 1.

Close to the engine room floor, a tee is inserted and bushed down to ¾-inch and ½-inch, the ½-inch pipe running to the crosshead and guides, while the ¾-inch pipe runs to the crank, main pillow block and eccentric. A pipe is also run from the one supplying the main pillow block across below the floor so as to supply the outer pillow block. All of the vertical pipes are reduced to ½-inch and are constructed of brass above the engine room floor. The pipes are run to brass cocks, one end of which is reduced to ⅛-inch and fitted into the oil cups as shown or attached so as to drip on the wiping device, as the case may be.

The oil cups are of the ordinary type soldered at the filling hole and so made suitable for use. The piping for the ecentric, main pillow blocks and crank, etc., is shown in the illustration, Fig. 2.

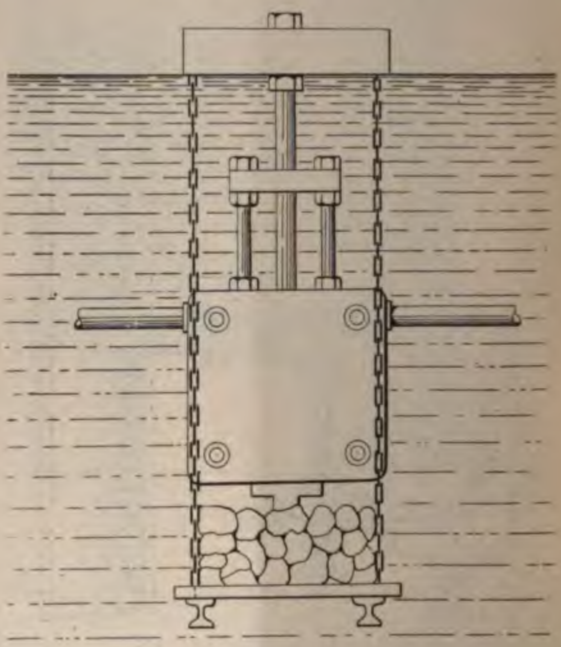
The waste oil is drained into an oil filter which is located in the basement, from which it is pumped back into the storage tank for use again.

W. S. Graves.

An Automatic Pump.

Editor of the Engineers' Review:

It is not very often that we find a steam pump operated without the aid of steam pressure in some manner, but the following is how a pump was made to do duty without the aid of steam, compressed air, or other power requiring the expenditure of money. The pump was used to fill a tank and arranged to work as follows: There is scarcely a day when Lake Michigan does not have waves at least a foot high. With this fact in mind it was figured out that if the pump was submerged in the lake and the plunger fitted with a float the action of the waves would pump sufficient water to the tank for all requirements.



THE SUBMERGED PUMP.

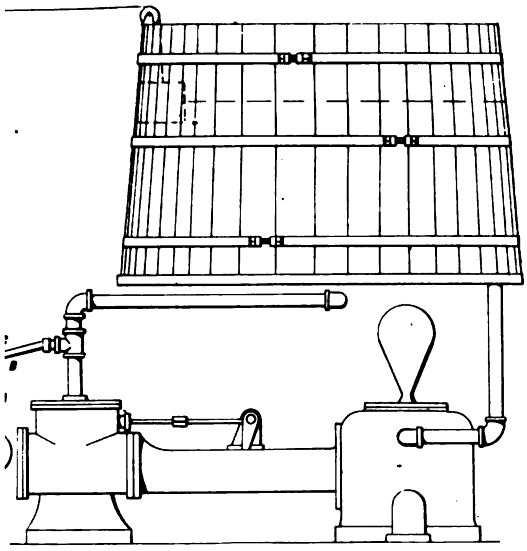
rder to carry this idea out, a platform
lt to fit around the top of the base of an up-
mp. The pump was then set upon a flat stone
ottom of the lake and two lengths of ordinary
rail placed on the base as weights. On the
platform was laid, which in turn was loaded
ith rock to hold the pump in position against
n of the waves. Chains were then run from
to the float, and of such length as to keep the
of the float less than the stroke of the pump,
le thing being so situated that the float was
ubmerged when the lake was perfectly calm.
ions were then made to the tank and the pump
dy for operation.

s found that the waves operated the pump suc-
and supplied all the water that was required.
he waves were exceedingly high, the float was
se, entirely submerged, but the chains pre-
it from knocking the piston against the ends
ylinder. E. B.

Another Pump Regulator.

f the Engineers' Review:

ice along the line of a pump regulator which
n operation is not only handy and easily made,
s good satisfaction. It consists of a float to
s attached a cord, passing up over a pulley
to the top of a tank and down over another
to the side beam of the housing, and on down



ULATING ARRANGEMENT FOR A TANK PUMP.

pump. The cord is fastened to a rod at the
hrottle, which is secured in a vertical position
it will move freely up and down as the weight
ank directs.

e rod are two stops which may be adjusted by
ews as shown. The nearer the stops are to-
the more evenly the water level will be main-

e steam pipe of the pump a Crane throttle valve
ced, with a piece of metal secured to the han-
ing a hole drilled in it through which the rod
passed, the hole being large enough so as not to bind the rod when in the position shown, or in a higher position.

The operation is simple. The illustration shows the throttle valve of the pump shut off and the pump not working. If, however, the water supply in the tank is lowered, the float drops and the stop *A*, rises until it hits the lever *B*, of the throttle valve, and opens the throttle, when the pump starts. This continues until the tank is full enough to raise the float so as to cause the stop *C*, to strike the lever on the other side and close the valve. This is brought about by having a weight *D*, attached to the rod below the stop *A*, heavy enough to swing the lever shut, and no more. Of course the float in the tank must be heavy enough to operate the arrangement. In this way an almost constant water level is maintained and the annoyance of either having the tank running over or half empty is done away with. K. R. Burton.

Bill B. Banger on Grafting.

Editor of the Engineers' Review:

Somehow or other trouble never seems to come single, for I no sooner square myself with the boss, or the gang around town, than something crops up to upset all calculations and well-meant resolutions.

The letter by W. A. E. on "Grafting Among Engineers" and the editorial about graft, both of which were published in the September issue of the Review, were read by myself with a whole lot of enjoyment as I thought over how some of the fellows must have squirmed under the hot shots that were fired.

There is an old saying that it's a poor rule that won't work two ways, and it is true. I did considerable figuring as to who were the probable grafters around town in the engineering profession. The boss in the office must have read the same articles, but he didn't cast his eye around town, not by a jug full. His mind was centered right on Bill B. Banger. His suspicions had become aroused, and it was up to me to knock them higher than a kite.

The first I knew of it was one morning when he came around and began to hint round as to the cost of supplies and what a chance there was for a fellow to make a rake-off if he was built that way. He asked me if I was getting as good satisfaction from the goods I was getting at the price I was paying, as I could by using another grade of goods. Of course I naturally got right up on my dignity and the way I talked would have made anyone think that there was no one any more honest in his dealings than your uncle Bill. I showed him, or tried to, that there wasn't the ghost of a chance of Bill B. Banger working the graft racket on him, but all I wanted was honest goods at an honest price with no bouquets thrown in from the salesman.

After the boss had gone, apparently satisfied that matters were all right, I sat down and began thinking the thing over, summing up the pros and cons this, that and several other ways and multiplied a few words with myself about the matter of graft. When I got through I just had to admit to myself that I had been telling the boss some of the blamedest lies that he had had strung out to him for some time. Perhaps I am a little hard on myself, as what I told him was not with

Licensing Firemen.

or of the Engineers' Review:

would like to know what the objection is to a fire- having a license as well as the engineer. What is l for one ought to be good for the other, for they go hand in hand and it can be summed up in one d, jealousy on the part of the engineers. The fire- with a license is as much under the orders of the neer as he is without.

believe a man can be a good engineer without ving how to fire. I fail to see why a machinist ıot be a good engineer. If I were a chief engineer large plant, whether I was a machinist or not, I ld for my benefit learn to fire by going into the oom to obtain practical experience.

notice that A. F. S., page 17, October Engineers' iew, asks how much oil should be used. My an- is, no man but the one in the engine room where machine is can answer his question. He should ble to tell himself, as we all have to do. I advise to use his own judgment. H. Armstrong.

Gear Grease—A Question.

or of the Engineers' Review:

ıe following is a very good compound for lubri- ıg gears: Use two parts linseed oil, four parts w and one part black lead. It is better to apply with a brush when the gears are in motion.

would like to ask the readers of the Review a tion. I have charge of a small plant in which we ıerly used two 14-foot by 48-inch boilers, set side ide. Both boilers were piped the same, fired alike did the same amount of work. In washing out I d soft mud in one boiler and no loose scale, while ıe other I found loose scale, but no soft mud to k of. Each boiler was run two weeks at a time een washings. We afterwards installed another r by the side of the one in which the loose scale cted, and the conditions became the same in all boilers. I would like to have someone tell me t caused the change after the third boiler was put

Smut Face.

Help for Helpless.

or of the Engineers' Review:

'e have a 12 x 12-inch high speed engine running revolutions a minute which has given us consider- trouble during the past year. At times it would ıd terrifically and again it would run as quietly ould be desired. As the symptoms were the same hose described by Helpless in a recent issue aps the same remedy will effect a cure in his case ı ours.

'e at first supposed that the knocking was in the rnor and endeavored to stop the noise by renew- the pins and bearings, as a similar trouble a few s previous had been remedied in that manner. making any improvement we turned our atten- to the valve with no better results.

bout a month ago the packing rings on the piston ng become so worn that they leaked considerable n, we put in a new set and the mystery was d.

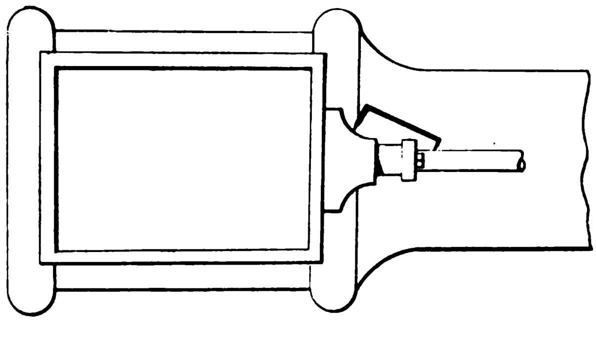
ıe engine has been a model of good behavior every minute since and we have had to take back a good many mean things we had said about the governor and valves. Slack cylinder rings are apt to produce a nerve racking pound, which is most likely to occur at times of light load. Opening the cylinder drip valves will usually cause the knocking to stop and pumping in oil and graphite will sometimes stop it for a while.

M. S. Howard.

Lead on Steam Valves.

Editor of the Engineers' Review:

The controversy that has been going on, over compression *vs.* noncompression and lead *vs.* no lead brings up a subject which was doubtless discussed by engineers years before many of us were born. The object of lead is to enable the steam to act as a cushion against the piston before it arrives at the end of its stroke. This causes it to reverse its motion without shock and also supplies steam at full pressure to the piston the instant it has passed the dead center. The higher the speed and the more irregular the work, the more lead should be given an engine.



TRAMMING FOR DIFFERENCE IN VALVE SET WHEN HOT OR COLD.

Lead has a disadvantage in one way because it acts counter to the motion of the piston. With lead, the steam enters the cylinder before the piston completes its stroke and, therefore, the engine has to complete its stroke with steam that has lost its power against full boiler pressure, which requires the use and consequent loss of a part of the power which has been accumulated in the flywheel. Whether the disadvantage is outweighed by the advantage is a matter which each engineer must judge for himself, but the fact remain, nevertheless.

Engineers make a mistake by setting the valve of the engine while it is cold. If one wants to see the difference in the action of an engine valve when cold and when hot, especially with rapid running engines, I advise them to test them for lead by means of a tram as shown in the illustration and a good many will be surprised at the difference in the result. The valve stem should be marked when the engine is cold and on one of the dead centers and then note the difference when the engine is hot, having been working all day. The only proper way in which to adjust the valves of an engine is to do it while the engine is hot, using the indicator to verify all that has been done. The valves may not be exactly right when the engine is cold, but it is sure to be when it is running and that is the time when accuracy is required. R. W. Diefendorf.

Babbitting a Loose Pulley.

Editor of the Engineers' Review:

In babbitting a loose pulley which has become worn, first remove the old babbitt. Then make a base, to which secure a round piece of wood, standing vertically as shown at *A*, in Fig. 1, the base being a trifle larger in diameter than the pulley. In order to get the pulley in a position to babbitt, place it upon the core base, and after leveling across the rim of the pulley move it so that the core *B*, stands exactly in the center of the hole in the hub, as in Fig. 2. A collar, the same size as the core, which has previously been put on, is brought up against the bottom of the hub and secured in place by means of the set screw, and the crack between it and the hub filled in with plaster of Paris. After plugging the oil hole with wood, pour the babbitt in around the core and allow it to cool. When cool it will be found that the core has been reduced in size a trifle which allows it to be removed from the pulley with ease. All that is then necessary is to scrape the babbitt until a good fit is made to the shaft, when the job is completed. B. S. Dreckers.

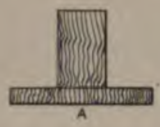


FIG. 1. BASE AND CORE.

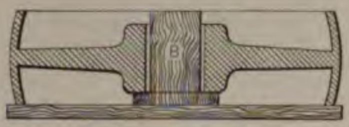


FIG. 2. PULLEY READY FOR BABBITTING.

A First Lesson With the Indicator.

Editor of the Engineers' Review:

It is seldom that we read concerning a subject, but that the text brings up recollections of our own experiences, if we have had any along the line of which the matter touches. The articles on indicators have recalled the first experience I had with that instrument.

I had been operating engines for several years, but had never had any experience with the indicator, and so I started off one day when I had no work, to the plant of a friend who understood the use of the instrument.

His engine ran at a speed of 110 revolutions a minute, which is rather high for a greenhorn to begin operations on, but as my friend was good enough to get out his rig and connect things up, I made up my mind that I would do the trick of connecting the hook on the cord to the pin in the crosshead if it took all the afternoon.

The arrangement he had for connecting the crosshead to the hook on the indicator card is shown in Fig. 1. It is a pin threaded at one end and screwed into a hole in the center of the crosshead, being bent up at right angles on the outer end as shown. This is all right for a man who is expert in gageing its motion as the crosshead moves back and forth and understands just when to drop the hook over the end of the pin at the right time, as well as detaching the same.

After my friend had successfully engaged and disengaged the hook several times, it was up to me to do the same if I could. With an engine running 50 or 60 revolutions a minute, the job might have been comparatively simple, but running 110 was a different m
ter and I never realized that the crosshead of an
gine at that speed traveled so fast and consumed
little time in getting from one end of the guides to
other.

The first attempt was a failure and the engine d
first blood, as when I made a jab to engage the h
the turned up end of the pin got in its work on the
of my hand. Not only once did this occur, but sev
times, in fact, by the time the operation was bro
to a successful close, the back of my hand looked
a battle scarred warrior, covered with gore. I
the satisfaction, however, of getting onto the knac
engaging and disengaging the hook of the indic
cord to the crosshead pin. I later on designed a
as shown in Fig. 2, having a small ball in place of
turned up end.

The next process was that of thoroughly clea
and oiling the indicator which consumed some t
and then came the process of figuring out the car
determine the horsepower. This was an interes
afternoon for me, and one which has proven of g
value since, because it created a desire to know m
about indicators, and only a few months elapsed
fore I was the proud possessor of such an instrum
which I have at the present time.

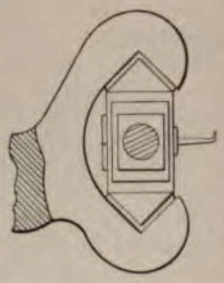


FIG. 1. PIN BENT UP.

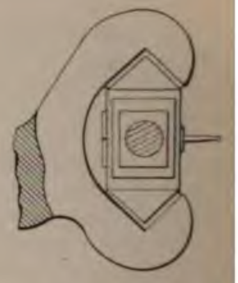


FIG. 2. PIN HAVING A B
ON THE END.

I owe more to my friend than he knows or p
ably ever will. I also learned a lesson which is
it pays to ask questions if one really wants to lear

The plant where I first took up the practice of u
the indicator is a thing of the past and a newer
better one is doing its work, but I shall never fo
the old plant as it looked that day when I took my
lesson in using the indicator. R. O. W

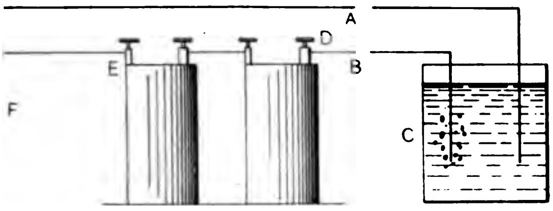
Recharging Dry Batteries.

Editor of the Engineers' Review:

Doubtless many readers of the Review have had
batteries in their possession, which after a time
their strength and were thrown away as useless
the belief that they were beyond repair. Dry batte
will not only give out, due to excessive use of the
rent, but also from standing idle upon the shelf w
not in use.

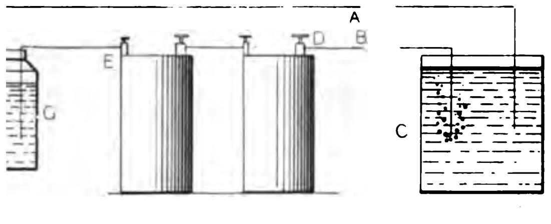
When such batteries are not corroded badly at
connections, or the zinc shell eaten through, they
frequently be recharged and made practically as g
as new. Sometimes they will give better service a
recharging than before.

e first thing to do when batteries have refused to ate current is to look at the connections which have become broken or corroded. If, however. rcuit seems to be all right, an examination should ide of the cells to see if the zinc shells are sound n good condition. If the shells are not eaten gh, the batteries may be connected up as shown g. 1, having a lamp in the circuit to act as a re-ce. If the lamp is not handy, a jar of water may ed as shown in Fig. 2.



. BATTERIES CONNECTED WITH A LAMP AS RESISTANCE.

ving arranged the batteries and the lamp, or jar as a resistance, allow the two wires, *A B*, to be rged in the jar of water *C*, in which a little sal-niac has been dissolved. It will be noted that one will give off a greater number of bubbles than her. This wire should be connected to the car-rminal *D*, of the batteries through the wire *B*. ther wire should go to the zinc terminal E, gh the wire *A*, passing through the lamp *F*, in , or the jar of water *G*, in Fig. 2. Having con-l the wires *A* and *B*, properly, they should be con-l to a 110-volt main, allowing the current to pass gh the cells for about half an hour. It will be a help if a hole is melted through the wax of cell, and then submerge it in water for a few before the current is passed through the cell. removing from the water, the hole should be d up again by remelting the wax with a hot iron.



BATTERIES CONNECTED WITH WATER AS RESISTANCE.

attery may also be made to do good work after been run down by constant use or a short circuit, nnecting the wire with the carbon and the wire cting with the zinc terminal together, and allow rrent to pass through from eight to ten minutes, it will be found that the battery has become in-r restored, thus avoiding the necessity of letting ttery stand for a day or more. If engineers who un-down batteries will try this scheme they will will work to their advantage. Wm. Hopkins.

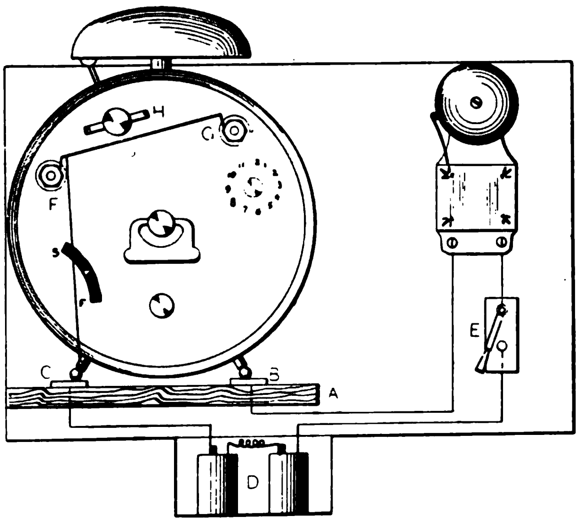
Electric Bell Alarm.

Editor of the Engineers' Review:

The following is a description of an apparatus, which though nothing new, is most convenient for the man who is more likely to sleep in the morning than to get up and go to work. I have made several such alarms as shown in the illustration, which have always served their purpose.

If there is one thing more than another that will unfit a man for his daily work, it is to suddenly awake in the morning and find that he has overslept half an hour or more. He will as a natural course hurriedly dress and rush off to work without his breakfast, not because he wants to, but because he is an engineer and things won't move until he sets them going.

Before I got my electric alarm arranged I had all kinds of trouble. Sometimes I would wake up too early and then remain awake until it was time to get up, fearing that if I indulged in another nap I would oversleep. I had an alarm clock, but after the first morning or two I never heard it go off. Someone suggested hanging the clock on a string from the headboard of the bed, which I did, but I kept on sleeping just the same. Some other kind friend suggested that I turn a pan upside down, placing it on a chair by the head of the bed and placing the clock on the inverted pan, claiming that when the alarm went off it would raise the dead, but it didn't. After the first morning or two I never knew whether it went off or not. As things were getting into a strenuous way, and going without breakfast was not conducive to good health, I knew it was up to me to make some arrangement whereby I was sure to wake up.



ELECTRIC BELL ALARM.

The illustration shows the arrangement, which consists of an ordinary 75-cent alarm clock, two batteries at 50 cents each and an electric bell costing half a dollar. The wire and salammoniac for the batteries cost about 25 cents more, so it will be seen the whole arrangement can be purchased for a small sum. The way the clock and connections were made is as follows: Obtaining a piece of black walnut, I made a neat shelf upon which to set the clock as shown at *A*. On the shelf *A*, were placed two contact blocks *B* and *C*, which were countersunk for the legs of the clock to set in to prevent it from jarring off when the alarm operated and also to make a good contact. From the contact *C*, a wire was run to the batteries *D*, two in number, which were connected together as shown. The batteries were in this instance placed in a cupboard fitted to the shelf, but they can, of course, be placed anywhere convenient. In connecting the batteries the carbon and zinc terminals should be connected together and a carbon terminal connecting with the contact *C*, while the zinc terminal of the other battery is connected to the switch *E*.

This switch consists of a contact block set in one end, and a brass lever connected to the battery through the pivot terminal which allows the circuit to be opened and closed at will. From the upper terminal of the switch the wires run to one of the terminals on the bell, while from the other bell terminal a wire is run to the contact block *B*, on the shelf, thus making a complete circuit between terminal *C* and *B*, through the batteries, switch and bell.

The manner in which the clock was arranged is as follows: The two nuts *F* and *G* were unscrewed and the alarm key turned as shown at *H*, and the handle soldered firmly in that position. Then a piece of wire was bent to fit around the small studs from which the nuts *F* and *G*, were taken, but insulated from the clock, studs and nuts, and bent out enough to come in contact with the alarm key as it starts to revolve when the alarm goes off. It is a good idea to turn the alarm key *H*, around about one-half or two-thirds of a turn before securing the contact wire *J*, in position.

An insulated wire is soldered to the end of *J*, as shown and the other end soldered to the leg coming in contact with *C*. In order to set the bell for operation the alarm key is turned around as shown at *H*, and set to go off at say 5 o'clock. The clock is then placed in position on the contact piece at *C* and *D*, while the switch *E* is thrown over, so the end of the lever comes on the contact block.

The engineer can then retire with the assurance that something will happen at 5 o'clock when the clock will allow the alarm key to turn until it makes a contact with *J*, thus completing the circuit, as the other leg of the clock is not insulated. When the circuit is completed, the electric bell will ring until the engineer gets up and turns the switch, which in my instance I always had located on the other side of the room so that it was a case of necessity to either get up, or lie and listen to the bell. Some prefer to have the switch located on the head of the bed, but this is a mistake as a fellow will soon get in the habit of reaching up and turning off the switch and never know it, thus defeating the object of the arrangement. E. K. D.

Old Time Engineering No. 2.

Editor of the Engineers' Review:

It takes a small matter to change the destiny of a man's future, or even govern the matters which concern life and death. The instance which I will attempt to portray in this letter occurred one July morning about nine o'clock. Matters had been going along smoothly for something over a year, both in the engine room and powder mills, when one of the mills located about 350 feet from the front of the he felt the swirl of something as it passed by et.

swirling sensation he had felt was found to have caused by a 4 x 4-inch timber which in descend- nbedded itself so solidly in the bed of the race- hat a pair of horses could not move it when at- s were made to pull it out.

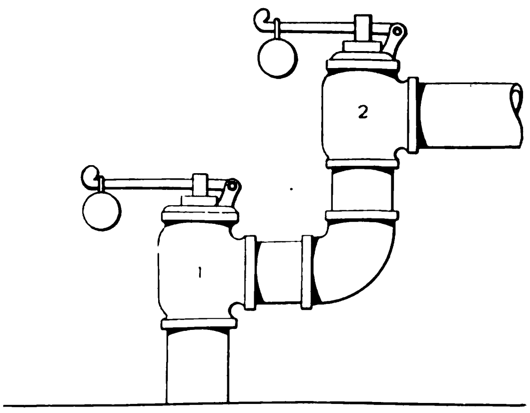
e would suppose that after so narrowly escaping as these two men did, they would conclude owder making was too dangerous a business for to pursue, but such was not the case. The man wed his life to the fact that he was not working ay continued to work there for years and eventu- ave up the work of his own free will. Bibbie, on ther hand, worked there until his death which red some years after, not in the mill, but by hav- small red hot coal roll from the furnace doors the fireman was cleaning the fires, which ignited owder saturated clothes, and before assistance be rendered, he had been burned so badly that d.

Old Timer.

Mr. Cooley's Safety Valves.

r of the Engineers' Review:

eems to be pretty hard for some of your readers Mr. Cooley's safety valve puzzle settled, but it is l with me. The other day after reading the let- ritten by "Doubtful" in the September number, t to work and rigged up two safety valves as near t as I could and attached them to a steam pipe, r to those in the illustration, with gage and valves ntrol the steam pressure. After I had operated for half an hour I became thoroughly convinced t takes 200 pounds of steam pressure to operate vo valves. It must be remembered that the back re 100 pounds has as much to do with holding valve disk down, as the ball and lever does with- ny back pressure. If we have a pressure of 100 ls in the space between the valves it will take a more than 100 pounds to raise valve No. 1 and you see the weight will require another 100 ls, which is 200 pounds pressure on the boiler. ne one has said that we have no back pressure, but because when valve No. 1 opens, steam rushes to the space between No. 1 and No. 2 and at a velocity of 902 feet per second at 100 pounds pressure, but this velocity does not exert a pressure of 100 pounds per square inch on No. 2 valve disk and therefore cannot raise this valve, but it does quickly fill up this space and soon does so, until it and the weight seats No. 1 valve again. It will not raise until steam rises higher in the boiler and when the steam in the boiler has reached a pressure of 200 pounds or a little more, it then overcomes the back pressure and weight and finds its way to the atmosphere.



VALVE NO. 2 REQUIRE TWICE THE PRESSURE TO BLOW IT AS VALVE NO. 1?

The safety valves I used were 1¼ inches in size and were coupled to a 1¼-inch steam line carrying a pressure of 100 pounds.

I first tried valve No. 1 to see at what pressure it blew off at, with No. 2 disconnected. I then removed No. 1 valve and tested No. 2 the same as No. 1, having both blow off at a pressure of 50 pounds. I then placed them both as shown in the illustration.

Holding No. 2 valve open, I admitted steam to No. 1 valve through a globe valve placed between it and the boiler until the gage registered 50 pounds. At that pressure No. 1 valve blew off. I shut the globe valve and allowed the pressure to escape and then allowed both safety valves to seat, when the steam was turned on again until there was 50 pounds pressure. I could then hear the steam escape past valve No. 1, but it soon closed and did not open again until the pressure reached 100 pounds, when the steam blew through both valves. I tried this experiment several times with the same result.

Texas.

Boiler Setting.

Editor of the Engineers' Review:

I have just noticed in the Review of July last an article entitled "A Peculiar Battery of Boilers," in which G. M. B. dubs it the most foolish arrangement in the engineering line he ever saw; and goes on to state that the manager of the saw mill where the boilers are installed informs him that such boilers have been in operation in Wisconsin for about two years.

The circumstance leads me to say that I have been manufacturing saw mill machinery (not boilers) in the midst of the great saw mills of Wisconsin and Michigan since the year 1865; and nowhere in all that region (Menominee, Marinette, Muskegon, Manistee, Saginaw, almost everywhere) were boilers installed in any way differing from the manner shown in his illustration. That was the universal practice for 50 years, and is yet to some extent; only the boilers were of two-flue mainly, 48 to 50 inches in diameter by about 24 feet long.

The mud drum with large nozlzes as a means of maintaining a water level in a battery of from six to twelve boilers has no equal. The steam drum provided an equal delivery of steam, and when it is considered that mill men wanted boilers that would consume as much of their sawdust, bark, etc., as was possible, the old two-flue was just the thing. More than that, the equipment fitted the capacity of the average engineer of those times.

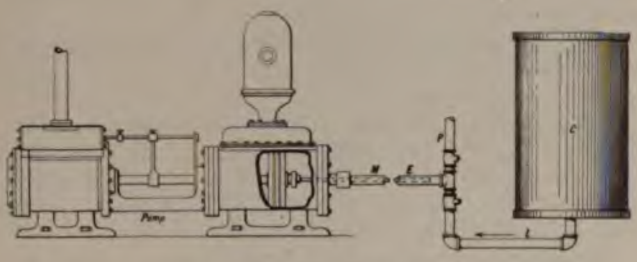
The rear ends of the boiler rested on heavy boiler stands, the forward ends on half arch fronts. That Canadian lumberman knew what he was about.

D. Clint Prescott.

Apparatus For Feeding Soda to Boilers.

Editor of the Engineers' Review:

The following is an arrangement whereby a solution of soda may be fed to a boiler at the convenience of the engineer. As will be seen, the pump piston is equipped with an extension on the water end. The piston-rod *M*, is ⅝-inch in this case and the pipe *E* is ¾-inch in size. The suction pipe is shown at *L* leading from the tank *C* which contains the soda solution. The discharge is through the pipe *P*. The operation of the apparatus is obvious. Yarled.

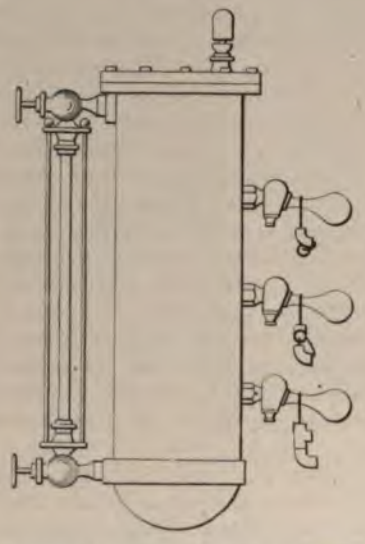


SODA FEEDING APPARATUS.

Up-to-Date Practice.

Editor of the Engineers' Review:

When we read all the discussions regarding the license law, we would naturally suppose that in a state or city having such a law, the practice would be up-to-date in every particular, since every engineer would be obliged to have a license before he could operate a plant. It is interesting to visit engine rooms, and I do so at every opportunity. I scarcely ever enter a plant, but that I find something instructive showing how things ought to be, or how they ought not to be done. Although the engine is usually the most attractive part of the plant to most men, to me the boilers are of interest also, and in them we find more defects than anywhere else.



TRY COCKS LOADED WITH FITTINGS.

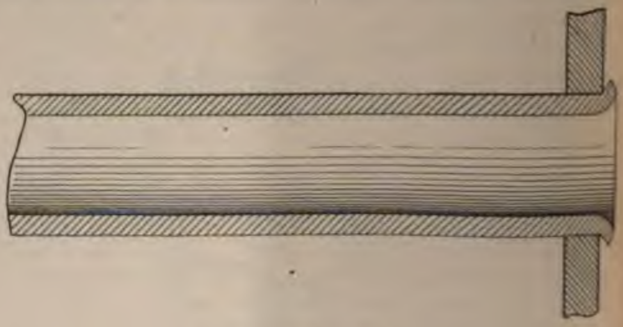
On one of my visits recently I saw a condition of things in connection with the water column that looked funny to say the least. The gage cocks were of the type necessitating the use of a pole placed beneath the handles and pushed up in order to operate them, as shown in the illustration. Sometime prior to my visit, however, the gage cocks must have got to leaking; at any rate there was some reason why each was loaded down with tee and elbow fittings. The general appearance of the water column is shown in the illustration. I didn't get to see the safety valve, but I presume that if it did not operate as the engineer thought it should, it was equipped with some sort of a patent stop arrangement as was the water column. The engineer, by the way, is a man who is a disbeliever in the license law. N. Lyman.

Beading Boiler Tubes.

Editor of the Engineers' Review:

A. C. Struckfus claims the proper way to put in boiler tubes is to bend them over, and that a tube projecting through the head will burn. He also says that from this cause they are dangerous and do not have the staying qualities the beaded tubes have.

I am always glad to learn, but I do not agree with him. I have put in many tubes and always have let them extend through the head about ¼-inch and before expanding them I swage them out slightly as shown in the sketch.



SWAGED TUBE.

I think a tube put in this way has better staying qualities than when beaded as it would have to bend in before drawing out and even if it should leak a little, it is nevertheless a stay. I have put tubes in a locomotive firebox boiler in this manner and never saw any of them leak, or injured in several years of use with forced draft.

I am not in favor of the beading of tubes because the very life of the iron is pounded out and a sharp angle is made and then the beading breaks.

Of what staying quality has it? Only what the expansion makes. Let them get a little loose and off goes the beading. With my method the harder the pull the closer the fit.

I believe as Bill B. Banger does, that firemen should have a license. Men working around steam boilers cannot know too much, whether in charge or not, and a license gives them a feeling of responsibility and something to look forward to. C. H. Prescott.

QUESTIONS
· OF THE HOUR ·

In this department questions concerning steam engineering of practical nature and of a general interest will be answered.

The name and address of the writer must accompany questions, but not necessarily for publication. We must know the source of the question.

---

(466) L. J., Blue Earth, Minn. Q.—"Will you work out an example for ascertaining the efficiency of triple riveted butt boiler joints?" A.—To find the strength of a triple butt joint, first determine the strength of the plate. Assuming that the plate has a thickness of ⅝-inch or .625, and that the pitch of the rivets is 7⅜ inches or 7.375 and that the plate has a tensile strength of 55,000 pounds, we have 7.375 × .625 × 55,000 = 253,516 pounds, the strength of the plate. The strength of the net section of the plate would be at the outer row. Assuming that the diameter of the rivet holes is 15-16, or .9375-inch, we have (7.375 — .9375) × .625 × 55,000 = 221,289 pounds. The rivets are, we will assume, ⅞-inch in diameter, or .6013-inch, or an area of .875-inch. If 70,000 pounds tensile strength is allowed for rivets in double shear and 38,000 for rivets in single shear, we have .6013 × 70,000 × 4 = 168,364 pounds shearing strength of four rivets in double shear and 38,000 × .6013 = 22.849, the shearing strength of one rivet in single shear. The total shearing resistance of the rivets is 168,364 + 22,849 = 191,213 pounds. As the rivets have a less shearing strength than the strength of the net section of the plate, we have 7.375 — .9375 ÷ 7.375 = .872 or 87.2 per cent.

(467) Same. Q.—"What constitutes the single and double shear in boiler rivets?" A.—The illustration Fig. 1, shows the rivet in double shear. It is evident that if the rivet is to shear it will be at one point only. In Fig 2 is shown a rivet in single shear. In Fig. 1, it will be seen that if the rivets are sheared off, it must occur in two places.

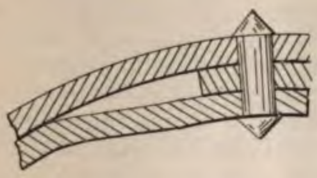


FIG. 1. RIVETS IN DOUBLE SHEAR

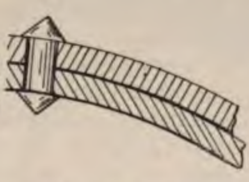


FIG. 2. RIVETS IN SINGLE SHEAR

(468) C. S., Chicago, Ill. Q.—"I am sending a diagram taken from a 20 x 42-inch Corliss engine running at 100 revolutions per minute. The boiler pressure is 100 pounds per square inch. The scale is 60 and the back pressure is 30 pounds. I would like to ask through the columns of the Review what can be done to get a better card. I cannot reduce the back pressure, as the exhaust steam is used to dry paper. Can any of your readers suggest a remedy? I would also like to know how to figure the horsepower." A.—We are reproducing the diagrams and invite any who have had experience with high back pressure to suggest a remedy for the same. It is frequently found to be of advantage to operate the engine as a reducing valve as appears to have been done in this case. It is doubtful that there can be any advantage in this instance, however, as the engine seems to be overloaded without any back pressure resisting the movement of the piston. If the engine were of greater capacity, or the load were reduced, the back pressure of 30 pounds might prove more economical than as if the steam were used direct from the boilers for drying the paper. The method of determining the horsepower is fully described on page 8 of the August issue, 1905.

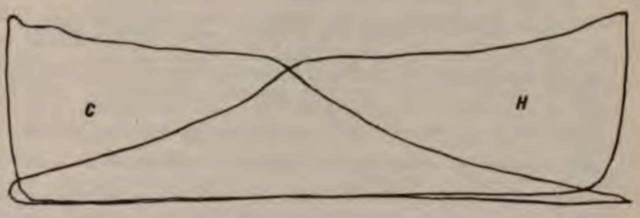


FIG. 3. SHOWING 30 POUNDS BACK PRESSURE.

(469) G. B. W., Indianapolis, Ind. Q.—"If I have two pumps capable of forcing water to a height of 50 feet only, can I force the water to a height of 100 feet if I connect the discharge of both pumps to the same discharge pipe?" A.—A pump having a steam cylinder 10 inches in diameter and a water cylinder 12 inches in diameter will force water to a height of 50 feet when a steam pressure of 50 pounds is used in the steam cylinder. Computing the piston speed at 100 feet per minute the discharge of water from one pump would be 1,174 gallons, no allowance being made for friction. A pump having a 12-inch cylinder would have a discharge pipe of 6 inches in diameter. To find the velocity in feet per minute at which this amount of water would discharge from the pipe, multiply the number of cubic feet of water by 144 and divide by the product by the area of the pipe in inches. The cubic feet in 1,174 gallons of water is 156.53 × 144 = 22,540.32. The area of a 6-inch pipe is 28.27 square inches. 22,540.32 ÷ 28.27 = 797.32 feet velocity. If the amount of water from two pumps is twice the amount of one pump we will have 1,174 × 2 = 2,348 gallons or 313.06 cubic feet, to be discharged through the same pipe. The velocity would be 313.06 × 144 ÷ 28.27 = 1,630 feet. Although the velocity of the water is increased by forcing a double quantity out of the same discharge pipe in a given time the force of steam acting upon a square inch of the steam piston remains the same, unless the area of each pump is increased. In order to get pressure enough to force the water 100 feet high the steam cylinder of the pumps would require a diameter of about 4 inches greater than if the water were to be forced a distance of 50 feet; or a cylinder 14 x 12-inch in diameter instead of 10 x 12 inches.

A standard horsepower: The evaporation of 30 pounds of water per hour from a feedwater temperature of 100 degrees F. into steam at 70 pounds gage pressure.

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THE COUNTRY'S FIGHT AGAINST CORPORATE DESPOTISM.

Manufacturers are sitting up and taking notice of the rate regulation campaign now about to open. It is of the highest importance to makers and purchasers of power plant equipment to secure fair and impartial freight tariffs. In the boiler business it is specially necessary. The freight is the factor that determines whether boilers, particularly return tubular boilers of the cheaper class, shall be bought in Boston or Philadelphia, Erie or Indianapolis, Chattanooga or Baltimore, and whether the United States or Europe shall sell to certain markets of the Orient, of which the Pacific slope is a natural source of supply. Discrimination in rates on coal are equally potent for favor or disfavor. President Roosevelt stands for a law that, after nearly 20 years of failure, will at last control the notorious abuses obtaining. He should be supported by builders and consumers of goods used in the power department, who should not be misled by the wails, threats and pleas, special and specious, of the railroad advocates of what the French call *laisser faire*, which in this case means, "hands off while we make money, be the consequences what they may."

Since the foundation of the United States as a nation no event, save the war against secession, has affected the entire people so profoundly (though not emotionally) and touched the individual so distinctly from the economic standpoint, as the freight rate. As administered for the past decade it has equalled climatic and meteorological influences in its control of the destinies of farmers, and commerce generally has found it no less masterful. The arbitrary decisions of those administrators as to which cities shall grow and which shall not, what sections shall smile with prosperity and which sicken with blight, the concerns, the individuals, that shall thrive and wax great as with the magic of Midas and those to be sacrificed to work the miracle, come nearer absolute control of the weal and the woe of a nation than the power of any monarch or oligarchy in history. The freight rate is the hand of fate.

It is not to be expected that this tremendous dictatorial power will be yielded without a prolonged, hard struggle, but it must be given over into the hands of the people. It has made enough fortunes huge as the Himalayas to menace our economic life. The well being of the nation demands equity in the wielding of an authority so dangerous. The coming two years will witness a supreme test of American democracy, *i. e.*, whether it can save itself from subjugation by corporate wealth. It is not probable that we shall for many years have as able or independent a spokesman for all the people in the White House as now, so that to many of us it is probably now or never.

The opposition, with unlimited resources and the sharpest minds of business and bar, will put up a fight that will probably stand out in relief as the acme of cunning and strategy, if not of wisdom. The great lawyers of the land are retained by them, and they own some 20 senators as certainly as Boss Cox owned his ward captains.

Some hint of the ground to be taken for defense is given in the position of a former secretary of state who declaims the inviolability of the right to control private property, as if this principle (which all admit unargued) were applicable to or is instanced by holdings created and procured by the exercise of the sovereign power of the state (the right of eminent domain) for the performance of a function for all the people, and favored with monopolistic conditions for the purpose of securing efficiency in the service of the public.

Our war for freedom from the despotism of boss billionaire corporations is now on in earnest.

THE ALLIS-CHALMERS STEAM TURBINE.

A steam turbine which was recently put into operation at the Washington street power house of the Utica Gas & Electric Co., Utica, N. Y., calls attention to the fact that this is the first turbine to be installed by the Allis-Chalmers Co., who have recently entered the steam turbine field. A photograph of this turbine is shown in Fig. 1.

This turbine is rated at 1,500 kilowatts, normal load, and runs at a speed of 1,800 revolutions per minute. It is direct coupled to an Allis-Chalmers 2-phase, 60-cycle revolving field alternator, operating at 2,500 volts. The unit has a continuous overload capacity of 25 per cent, with a 3-hour 50 per cent overload capacity without exceeding a safe generator temperature, and capable of 100 per cent safe momentary overload. Artificial ventilation by means of an electrically driven fan blower will, however, enable the unit to be run safely beyond its rated overload capacity.

The turbine follows the well-known Parsons type which has proven itself eminently successful in numerous installations both here and abroad. The Allis-Chalmers construction, however, embodies a number of features which are new in this country, and which are claimed by the builders to be distinct improvements.

The chief distinguishing feature of this construction is the blading, which, while it is of the Parsons reaction type as regards the principle of operation, differs in mechanical construction in a number of essential details.

The root of the blades are formed in dovetail shape by special machinery, and are inserted in slots cut in foundation or base rings; these slots being formed by special machine tools in such a way as to exactly conform to the shapes of the blade roots. The foundation rings themselves are of dovetail shape in cross section and are inserted in dovetailed grooves cut in the turbine cylinder and spindle respectively, in which they are firmly held by key pieces, much in the same way that the well known "Lewis bolt" is fastened. In order to further ensure the integrity of the construction, the key pieces or rings after being driven into place are upset into undercut grooves.

Another noticeable feature of the blading is the method of reinforcing and protecting the tips of the blades. This point in steam turbine design is one upon which much thought has been expended by various inventors, and the Allis-Chalmers Co., claim that the construction employed by them successfully solves all difficulties. In forming the blades a shouldered projection is left at the tip. This is inserted in a slot punched in a shroud ring; the slots being punched by special machinery in such a way as to produce accurate spacing and at the same time form the slots so that they will give the proper angles to the blades independent of the slots in the base ring. After the blade tips are inserted in the slots in the shroud rings they are riveted over by specially arranged pneumatic machinery.

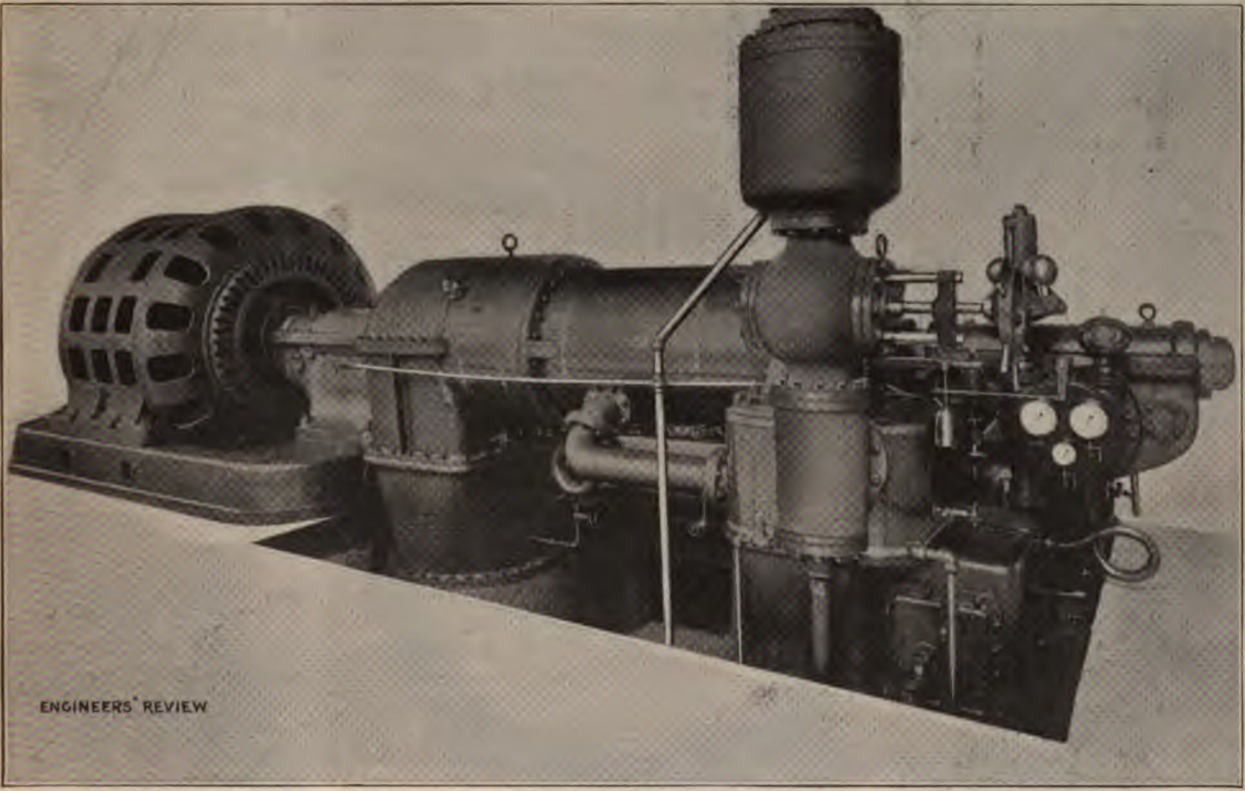


FIG. 1. THE NEW ALLIS-CHALMERS STEAM TURBINE.

The shroud rings are made in channel shape, with outwardly projecting flanges which, after assembly in the turbine, are turned and bored to give the necessary working clearance. The flanges of the channels are made so thin that, although amply sufficient for stiffness, the shroud ring does not have the disadvantage of a solid shroud which acquires a dangerous temperature by friction in case of an accidental contact of the rotating and stationary parts. It is claimed for this construction that the blades are stiffened against the effect of vibration in a much more substantial manner than by any other means thus far employed, while the use of a protecting shroud ring enables the working clearance to be made smaller than in the case of naked blade tips, without danger in case of accidental contact, thus reducing the leakage loss to a minimum; the leakage past the blade tips being the principal sources of loss in the steam turbine. As to the safety from damage in case of accidental contact, it is claimed that this has been proven by experiment with actual blading, by throwing the bearings out of center so as to produce contact, without detrimental results. An incidental advantage claimed for this construction is that if by chance a blade should prove defective, it is so held in place by the shroud ring that it cannot possibly work loose and produce damage.

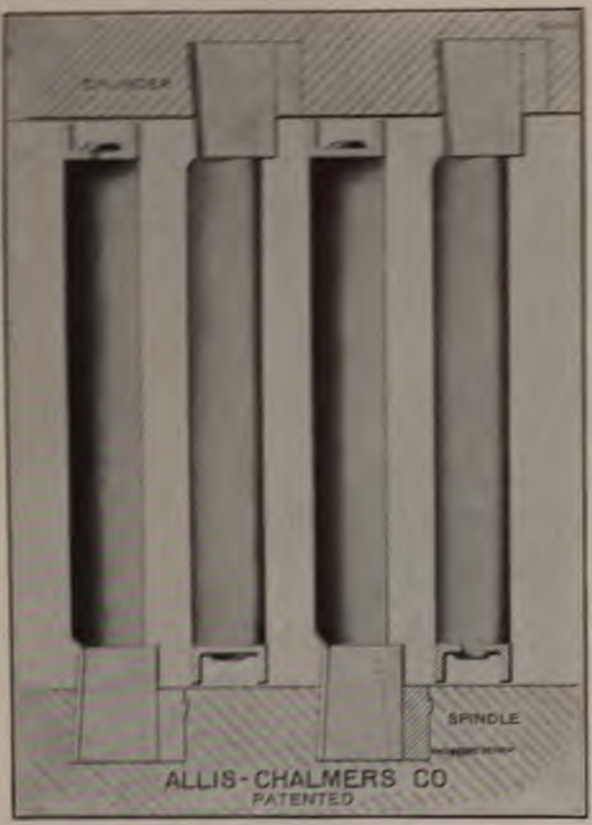


FIG. 2. METHOD OF FASTENING BLADES, ALSO SHOWING SHROUD RINGS.

By the method of construction described, the entire blading is produced by machinery, thus eliminating the personal equation which enters into blading done by hand work, which depends upon the skill of the individual workman. Besides ensuring that every blade is securely fastened, all blades are necessarily set at exactly the designed angle and pitch; the openings between blades, upon which in great part the economical performance depends, being absolutely uniform. The blading is made up in half rings in the blading shop and is carefully inspected before being inserted in the turbine.

Fig. 2 shows the general scheme of the blading, illustrating the method of fastening the blades as well as the channel shaped shroud ring. Fig. 3 shows two half rings of blades ready for assembly in a turbine, these half rings being respectively the smallest and largest ones, used in a turbine of the size installed at Utica. Fig. 4 shows the substantiality of the construction as well as the uniformity of the work. Fig.

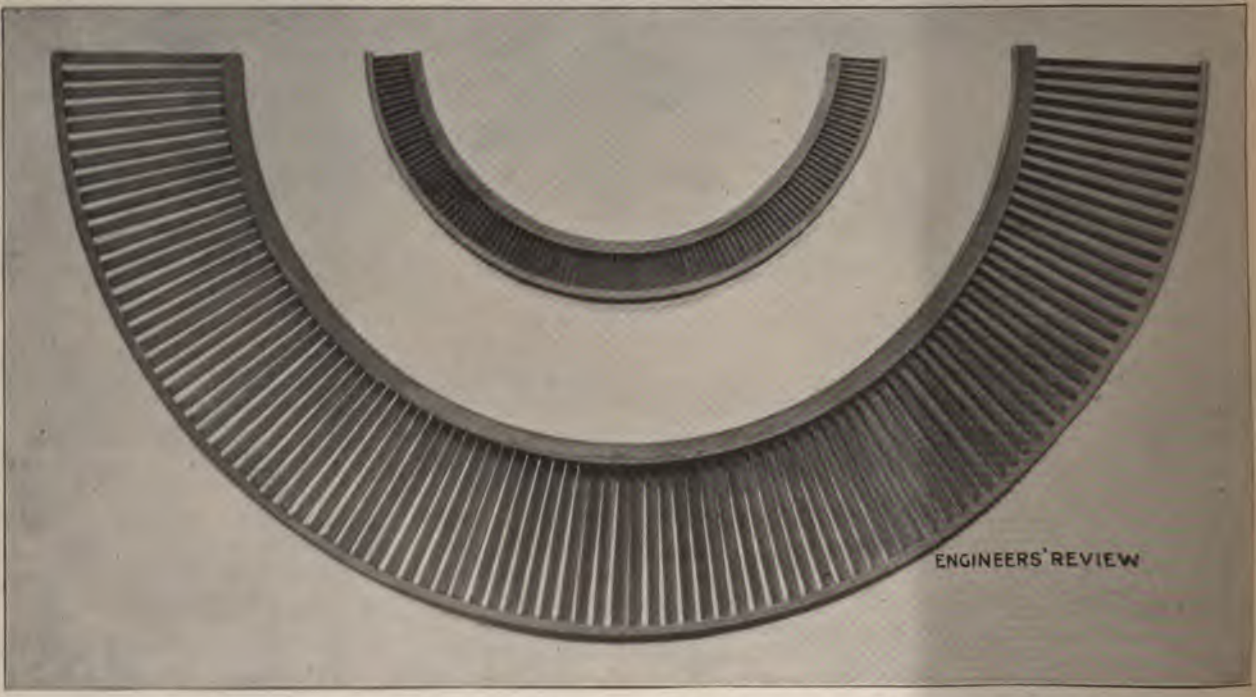


FIG. 3. SHOWING TWO HALF RINGS OF BLADES READY FOR ASSEMBLING IN A TURBINE.

5 shows a turbine spindle of the same size as that of the Utica turbine.

Another special feature of this turbine will be noticed by referring to Fig. 5, *viz.*, the absence of the usual low pressure "balance piston"; the photograph showing only two balance pistons instead of the three pistons formerly used in this type of turbine, where it is said to have been found difficult to produce a balance piston of the size required for balancing the low pressure stage of the turbine and at the same time make it sufficiently rigid to run with the necessary small working clearance. In the Allis-Chalmers construction there is, however, a third balance piston, but instead of being at the high pressure end of the turbine, as formerly arranged, it is at the low pressure end, and as it is smaller than the large end of the spindle it is hidden from sight in the photograph. By making this piston in such a way that its circular area is equal to the annular area of the pistons used in the older construction, the low pressure balance piston is made much smaller. Instead of reducing the leakage past this piston by means of "dummy packing," as in the high pressure and intermediate pistons, and as used in the low pressure pistons of the older construction, a labyrinth packing of radical baffling type has been adopted, thus eliminating small axial clearance in this turbine. A considerable advantage is claimed for this construction as it permits of the use of smaller working clearances in the high pressure and intermediate balance pistons.

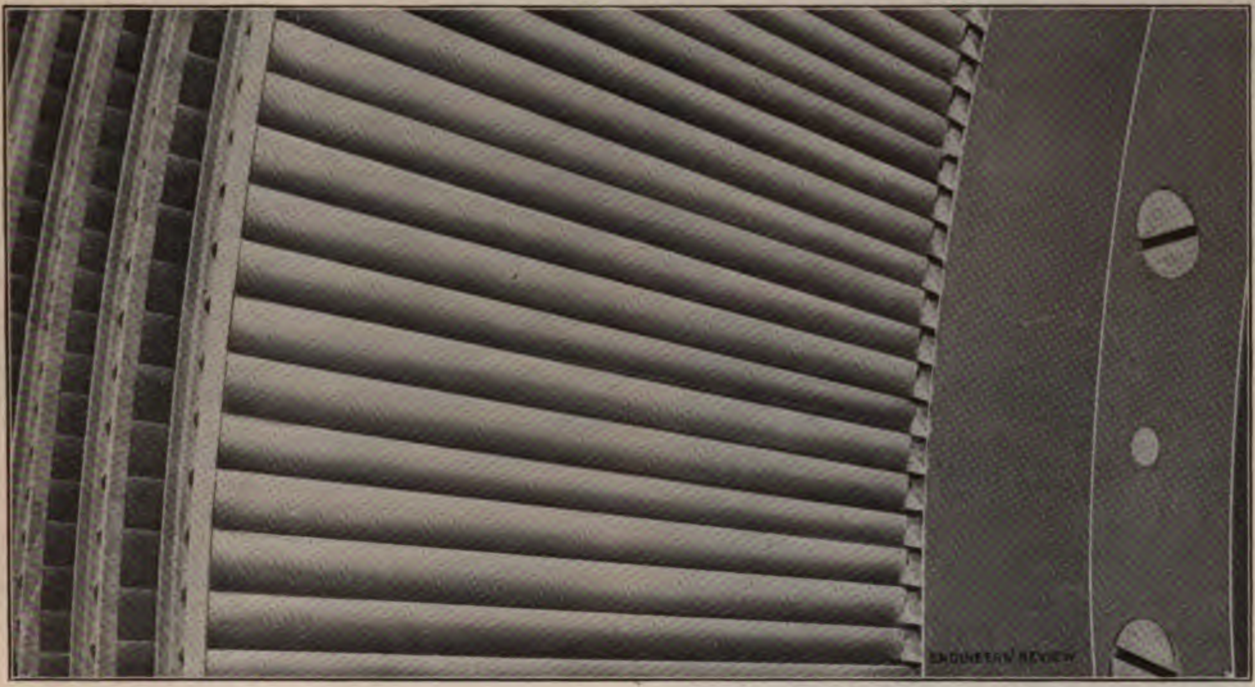


FIG. 4. SHOWING THE SUBSTANTIALITY OF CONSTRUCTION OF BLADES, ALSO THE UNIFORMITY OF THE WORK.

There are a number of other points of improvement claimed for the Allis-Chalmers construction which will not permit of description within the space of the present article. These include details of spindle construction, governing mechanism, lubrication, and other minor features.

The Allis-Chalmers Co., in entering the steam turbine field, effected an alliance with the Turbine Advisory Syndicate of England, thereby securing the cooperation of the firms therein interested, including Messrs. Willans & Robinson, the famous high speed engine builders, of Rugby; Yarrow & Co., the well known torpedo boat builders of the Isle of Dogs, London; and the Neptune Shipbuilding Works, Walker-on-Tyne. The Utica turbine, in fact, was built for the Allis-Chalmers Co. by Messrs. Willans & Robinson, to whom a number of turbine contracts were sub-let by the Allis-Chalmers Co. before the latter had perfected the installation of their special machinery for turbine manufacture. An agreement has more recently been effected with Hon. Charles A. Parsons, C. E., for interchange of data, thereby giving to the Allis-Chalmers Co. the benefit of the vast experience of Mr. Parsons, the original inventor of this type of turbine, and to whose engineering ability and indomnitable energy the evolution and present state of perfection of the successful steam turbine are principally due. The Allis-Chalmers Co. have also secured rights under Mr. Parsons' patents for marine turbines and turbo-compressors and blowers, for which there is a growing demand.

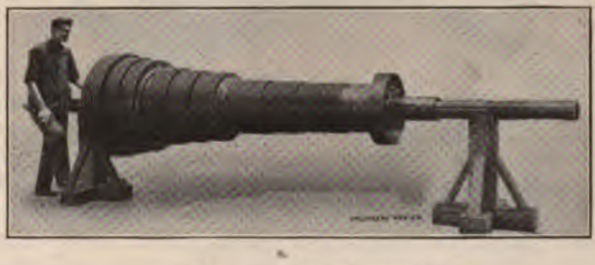


FIG. 5. TURBINE SPINDLE.

At present the Allis-Chalmers Co. are building their steam turbines in their engine works at West Allis, The growth of the business, however, has led to a large extension of the works, amounting to a practical doubling of the present plant. A considerable part of the extension will be devoted to the manufacture of steam turbines and the accompanying electric generators; one of the three new manufacturing buildings being given up to the exclusive manufacture of the turbines themselves. The first steam turbine of the Allis-Chalmers Co.'s own make, of 5,500 kilowatt capacity, has recently been shipped, and others are following as fast as the present crowded condition of the shops will permit.

NEW PRESIDENT OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Frederick Winslow Taylor was born in Germantown, Pa., 1856. He prepared for Harvard College at Phillips-Exeter Academy and entered the university at the age of 18. Because of failing eyesight he was compelled to leave college without finishing his course. Finding that the school was closed to him he decided to obtain his training in actual work and became an apprentice to pattern making. In four years he not only learned the trade of pattern maker but acquired a working knowledge of machine tools. During his connection with the Midvale Steel Works he managed, by studing evenings, to graduate from the Stevens Institute of Technology. He has since been connected with several companies in the iron and steel field and has done much work of an independent nature along engineering lines. He is perhaps best known through his connection with the Taylor-White high speed steel and because of his investigations to determine the cutting speed of tools. Mr. Taylor together with Sanford E. Thomson recently completed a book on "Concrete, and its Uses."

FREDERICK WINSLOW TAYLOR.

To find the pressure in pounds per square inch of a column of water multiply the height of the column in feet by .434.

MECHANICAL TUBE CLEANERS AND THEIR EFFECT ON BOILER TUBES.

The following article contains extracts from an article by Wm. A. Parsons in a recent issue of *Power*, being a report of an investigation made by him as to the effect of mechanical tube cleaners on boiler tubes. His report is in part as follows:

Three standard cleaners were obtained, representing the three different types on the market, which he designates as Nos. 1, 2 and 3. It was first thought necessary to determine the relative pressure at which the cleaners would do equally effective work in removing scale from boiler tubes under nearly normal conditions.

The different cleaners were tried side by side on adjoining tubes of the same boiler, and varying the pressure of the operating fluid until all three did equally good and effective work. It was found that cleaners Nos. 1 and 2 required 15 pounds pressure, and cleaner No. 3, 80 pounds pressure for equally satisfactory work. These pressures were maintained for each cleaner through the rest of the experiment.

In experimenting to ascertain the speed of the different cleaners, an apparatus was arranged so that a record was reproduced having holes perforated in them, each hole representing two blows of the hammer or vibrator. The result of this speed test is as follows:

CLEANER CHARACTERISTICS.

Cleaner No.	Type.	Stroke.	Cushioning.	Speed.	
				No. of holes in Record	Total No. of Blows per Min.
1	Lever actuated hammer	1⅜ in	Slight	1,989	3,6
2	Independent die	⅝ in.	None	3,347	6,179
3	Direct acting valveless vibrator	⅜ in	Considerable.	6 113	11,2

Next, each cleaner was tried in three samples of charcoal iron boiler tubes and then in three samples of mild steel boiler tubes. One sample in each case was standard thickness, another of three-quarter standard thickness and another of one-half standard thickness. Each cleaner was operated for a period of three minutes and the distortion, if any, was carefully measured at the end of each minute.

The result of these tests is found in the following table:

Tubes 3½ in. diam.		Time in Min.	Distortions in $\frac{1}{32}$'s of an inch produced by		
Material.	Thickness of Wall.		Cleaner No. 1	Cleaner No. 2	Cleaner No. 3
Charcoal Iron.	0.120" (Standard)	1	3	1	0
		2	4	1¼	0
		3	5	2	¼
	0.090" (¾ of Standard)	1	6	1	0
		2	8	1½	0
		3	9	2½	½
	0.060" (½ of Standard)	1	7	1	¼
		2	8	2	½
		3	9	4	1
Mild Steel.	0.120" (Standard)	1	2	1	0
		2	3	1½	0
		3	4	2	¼
	0.090" (¾ of Standard)	1	3	1	0
		2	6	2	¼
		3	7	2	½
	0.060" (½ of Standard)	1	5	1	¼
		2	7	2	½
		3	6	3	¼

will be seen by examining the preceding table that ner No. 1 produced by far the largest distortion, aging at least 14 times as much as cleaner No. 3, ch produced the least; while cleaner No. 2 averaged ly six times as much as cleaner No. 3. It will also noticed that so far as distortions by cleaners are cerned, not much difference exists between char- iron or the mild steel.

onsidering the possibility of a careless operator nitting a cleaner to run at one place in a tube for inute, it will be seen that no very important dision of the tube will take place through the use of of the cleaners on the standard gage, except, pers, in the case of cleaner No. 1, which was severest s action on the tube.

he possibility also of any damage to the tube being e by applying a pressure in excess of that recomided by manufacturers is also to be considered, n an ignorant or careless operator is employed. uch an event, the machine that operates at a pres- more nearly the normal boiler pressure of the age plant would be the safer type of machine to

n view of the opinion of an eminent authority, and ng into consideration the result of the test, Mr. sons is fully convinced that boiler tubes can be ned by a properly designed machine without strain- the metal of the tubes beyond the limit of elasy. On the whole his observation leads him to bee that the combination of a short stroke, a high d and proper cushioning are essential features of od cleaner and that a device possessing these qual-, if otherwise well designed, is a safe tool to use.

E ELEVENTH MEETING OF THE OHIO SOCIETY MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.

he eleventh meeting of the Ohio Society Mechan-, Electrical and Steam Engineers was held in the Hall building, Canton, O., Nov. 17 and 18, 1905. er the usual business of the society was attended to matter of amending the constitution to enable society to hold the semi-annual meetings outside he state was taken up. After considerable discus- as to the report of the committee in charge of constitution their recommendations were adopted. amendment so reads that the membership shall ude active, associate and honorary members. The includes all members in charge of power plants, associate embraces members who are indirectly nected to power plants; the honorary members con- of members who have in any manner brought or to the profession.

he following papers were read: Pumping Enes and Machinery, Oscar F. Rabbe, Toledo, O.; npressive Strength of Materials, Robert A. Ovin, E., East Liverpool, O.; Losses in Power Plants, rles N. Harvey, Zanesville, O.; The Heat Unit Its Application to Steam Heating, Geo. G. Ben-, Cleveland, O.: The Handwriting of Mechanics, gene Ransom, M. E., Akron, O.; and Electric *sus* Steam Locomotives, R. H. Probert, Akron, Several of these papers brought out considerable ussion.

t the evening session the following officers were elected for the ensuing year: President, Wm. T. Magruder, Columbus, O.; vice presidents, Oscar F. Rabbe, Toledo, O.; Herbert E. Stone, Cambridge, Mass., being appointed vice president to fill the place of President-elect W. T. Magruder; board of managers; C. J. Miller, Canton, O., and Robt. F. Hetzel, Dayton, O.; treasurer, W. D. Theobold, Canton, O.; secretary, F. W. Ballard, 52 Wallingford court, Cleveland, O. Six new members were elected.

After the morning session, Nov. 18, those who could, enjoyed the privilege of visiting the plants of the Buckeye Engine Co., Salem, O., and Morgan Engineering Co., Alliance, O. The next meeting will be held in Pittsburg, Pa. The first session will be held Thursday evening, May 17, 1906.

THE ELLIS ADJUSTABLE WRENCH.

This wrench is a recently patented and very useful tool. The jaws are on the end of an S wrench and the handle is so constructed that it works straight or can be thrown to the right or left, at any angle by means of a plunger pin which locks it securely in any position desired. It is shown in Fig. 1. It is a complete set of wrenches in one as it enables the operator to work around corners, behind pipes and inaccessible places where special wrenches would otherwise be necessary.

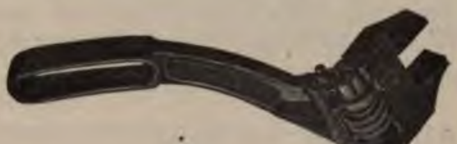


FIG. 1. HANDLE IN OFFSET POSITION.

By removing the sliding jaw, and inserting a special steel pipe jaw, a complete wrench is secured with all the adjustments as before, as shown in Fig. 2. It is easily adjusted for any size of nut or pipe, is always ready, saves time and is neat, strong and durable.

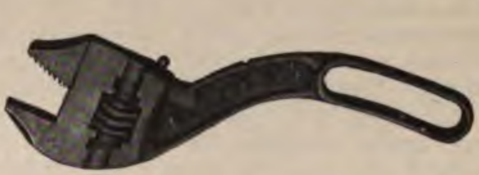


FIG. 2. WRENCH CONVERTED INTO A PIPE WRENCH.

The 6-inch wrenches are finished only in nickel. All other sizes in pistol finish. These wrenches are manufactured by The Offset Handle Wrench Co., 125 La Salle street, R. 720-730, Chicago, Ill.

A NEW HYDRAULIC PACKING.

The D. S. Paterson Co., Philadelphia, Pa., are now making a specialty of their style No. 3 (patent applied for) "Double Service" packing for high pressure hydraulic work, which has proven successful under 10,000 pounds pressure. A description of this packing is as follows:

First, there is a casing of special hydraulic tucks made in the shape of an inverted U, the special feature of which is its being made in one piece, in order to overcome the common obstacle of disintegration under pressure.

Inside of this inverted U will be found a half-diagonal wedge of antifriction alloyed metal to come in contact with the wearing surfaces. The other half of the diagonal wedge is composed of hydraulic tucks packing with a cushion of flax packing, both of which possess the ideal qualities for expansion and lubrication. The arched back of the U supplies the true mechanical principle for securing the maximum wearing service, since it depends exclusively upon the gland pressure for the take-up necessary to bring the diagonal wedge into proper operation; thus in a practical way pulling it "up to the wedge" to carry the burden of friction, which is positively reduced to a minimum by correct lubrication and expansion.

Style No. 3 has, it is said, all of the advantages of metallic packing, while offering every convenience of fibrous packing. That is, it is easily and quickly applied, and does not require rods to be turned.

AN ADDITION TO BELT LITERATURE.

An interesting series of comparative tests were made in January last on the belt testing machine of Sibley College, Cornell University, to prove the difference between and comparative value of Cling-Surface, Neatsfoot oil, and two belt dressings, one a representative of the semi-liquid form, designated here as *Z*, and one the solid form, designated here as *X*.

The Neatsfoot oil was the best obtainable on the market, the two belt dressings were supplied by their makers, the Cling-Surface was taken from the regular stock used in the college and received ten months previous to test.

The four materials were first subjected to chemical tests to ascertain presence of rosin, free alkali, ammonia, mineral and fatty acids. None of the first three were found in any of the materials. Dressing *Z* contained some free mineral acid. The amount of free fatty acid found, is as follows: Cling-Surface, 27-100 of 1 per cent; Neatsfoot oil, 70-100 of 1 per cent; Dressing *X*, 3.5 per cent; Dressing *Z*, 29.85 per cent.

Four new, similar, 4-inch, single ply, oak tanned leather belts were used. Each was tested first untreated. Then each was treated in the most careful manner as directed by the manufacturers. Each was then run at high speed for five hours. Then laid in a warm place for 36 hours. Then again treated and run for three hours. Then tested. The Neatsfoot oil belt, however, had no last treatment, to avoid a slippery face.

The load is applied in this machine by a Prony brake. The engine used had a limit in speed of 40 revolutions per minute.

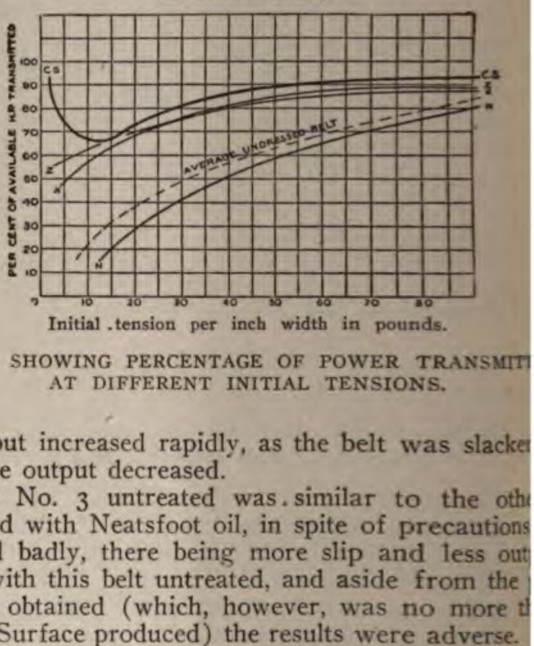
The following summary is extracted from the report:

Results from belt No. 1, with and without Cling-Surface: The untreated belt was rather stiff, and followed the usual theory of belting, *i. e.*, increase of horsepower, with an increase of initial tension. The slip and arc of contact were both steadily reduced with increase of tensions. The effect of Cling-Surfac this belt was marked: The belt was softened, given a peculiar clinging property without being ir least degree sticky to the touch. By referring to horsepower curve, we find an extremely high trans ting power, when the initial tension is only the we of the belt. As the tension is increased, this trans ting power decreases, until passing about 10 pou per inch of width of tension, then increases.

At maximum initial tension, the output is about same as on the lowest tensions, but we have the ter pressure on journals and shafting. The arc of con at slackest was 209 degrees. The slip was in no over 2 per cent; the Cling-Surface gave maximum sults at minimum initial tension, which means m mum results with least wear on machinery and Cling-Surface had no deleterious effect on the belt.

Belt No. 2 untreated was similar to No. 1. Trea with *Z* dressing the slip was reduced to about 2 cent, but increased rapidly, as the belt was slacke and the output decreased.

SUMMATION SHEET.



CURVE SHOWING PERCENTAGE OF POWER TRANSMITT AT DIFFERENT INITIAL TENSIONS.

Belt No. 3 untreated was similar to the oth Treated with Neatsfoot oil, in spite of precautions slipped badly, there being more slip and less out than with this belt untreated, and aside from the ability obtained (which, however, was no more t Cling-Surface produced) the results were adverse.

Belt No. 4 untreated, as the others, but more plial Treated with *X* hard dressing, it became distin sticky and power was lost in pulling the belt off pulleys, while some of the belt face was also torn.

Ranking the preparations according to their perce age of horsepower delivered, we find this order: Cling-Surface; 2nd. *Z* belt dressing; 3rd. *X* belt dr ing; 4th. Neatsfoot oil.

Ranking them in effect on shafting, the above holds, for Cling-Surface gives 40 per cent more po on lowest tensions than the next highest. Low sions means little strain on shafting and less lubri tion for bearings.

Ranking according to preservative qualities, we fi 1st. Cling-Surface; 2nd. *Z* belt dressing; 3rd. Ne foot oil; 4th. *X* belt dressing.

X cannot be considered a preservative in any se of the word.

It is, therefore, found perfectly feasible to run b loose. This means increased life for the belt, no s no burning of the belt, less wear in journals, less l rication, less straining of shafting and pulleys, more available power, few or no stoppages for repairs and no loss in time and product.

In short, the loose belt saves money in repairs and idle time, and makes money through the increased profit due to a larger output. We reproduce the curve sheet showing final results of tests in the percentage of horsepower transmitted at different initial tensions.

The Cling-Surface Co., of 154-160 Virginia street, Buffalo, N. Y., have published this report in full, and will send it to those interested.

NEW BOOKS.

“Engineering Practice and Theory” for Steam Engineers, by W. H. Wakeman, 64 Henry street, New Haven, Conn., fourth edition, 184 pages, illustrated, size 7½ x 5, cloth, price $1.00.

This volume is well known to those engaged as engineers and that it is popular is evident as this is the fourth edition. It is written in language that can easily be understood by those having only a limited education. The book contains 20 chapters, an appendix and 200 questions relating to the text. The duties of the engineer are taken up in the first chapter and followed by the various phases of engineering relating to boilers, engines, pumps and other subjects of interest to engineers.

“Modern Turbine Practice,” by John Wolf Thurso, D. Van Nostrand Co., 23 Murray street, New York, 6¼ x 9¼, 244 pages, illustrated, cloth, price $4.00.

This volume is written with the intent of giving such information in regard to modern turbines and their proper installation as is necessary to the hydraulic engineer in designing a water power plant. The author has shown the deficiencies of the present American turbine practice and has pointed out the direction in which improvement is to be sought. Part 1 deals with the modern steam turbine practice in Europe, its development and turbine pumps. Turbine practice in America is also dealt with and the lack of progress among American builders is noted. Under the head of classifications of turbines the different types are treated in detail and the modern steam turbine is explained both as to construction and operation. Part 2, contains information and data about matter connected with turbine plants. The book also contains a paper entitled Speed Regulation of Steam Turbines, by Allen V. Garrratt.

“Modern Locomotive Engineering” by Calvin F. Swingle, M. E., Frederick J. Drake & Co., 211 East Madison street, Chicago, 5 x 6¾, 630 pages, 265 illustrations, 6 charts, pocketbook style, full seal grain leather, with gold stampings and gold edges, price $3.00.

This is a volume dealing with the practical construction, care and management of modern locomotives. The object of the book is to furnish to locomotive engineers and firemen, as well as others who are interested, in a clear and concise manner, such information as will thoroughly equip them for the responsibilities of their calling. The subject matter deals in boiler construction as applied to locomotives. The leading types of valves and valve gear are fully described, also the method of setting them. An entire chapter is devoted to the study of the indicator and its application to the locomotive. The different types of compound locomotives receive attention, also equipment, including electric headlights and mechanical stokers. Particular attention has been given to the important subject of breakdowns, and what to do in cases of emergency. The subject of air brakes is also dwelt upon, including all new and improved devices for the safety of train running. The volume is written in plain, simple and explicit language throughout and is one of the most modern treatises on the subject.

NEW CATALOGS.

WEBSTER STEAM AND OIL SEPARATORS form the subject matter for an attractive little folder recently issued by Warren Webster & Co., of Camden, N. J.

A BARGAIN LIST which contains a list of numerous motors for sale is being sent out by the John A. Stewart Electric Co., 5th and Sycamore streets, Cincinnati.

A FEW STYLES of Detroit glass body oil cups and crankpin oilers are illustrated and described in a folder received from the Detroit Lubricator Co., Detroit, Mch.

A BOOKLET describing the Jacobs patent straight tube feedwater heater and the Lowden patent grease, oil and grit extractor was sent us by Chas. Jacobs & Co., 41 Oliver street, Boston, Mass.

A BOOKLET entitled “The Old Chestnut” has been sent out in the interests of Watts packings, especially their wedge packing. John W. Watts's Sons, Philadelphia, Pa., are the manufacturers.

A HANDSOME BOOKLET of 16 pages has been received from the Lunkenheimer Co., Cincinnati, O. This booklet describes their different types of regrinding valves which are already well known.

“THE MACHINE *versus* the Man” is the title of a brochure issued by the American Stoker Co., Erie, Pa. This contains an argument showing the efficiency and saving obtained by mechanical stokers over hand firing.

THE ABENDROTH & ROOT MFG. CO., Newburgh, N. Y., manufacturers of Root spiral rivited pipe, Root sectional water tube boilers, the A. & R. improved exhaust heads, etc., have issued a booklet containing a brief mention of their specialties.

WE HAVE RECEIVED a large postal card, on one side of which is printed a valve gear view of the new Lane & Bodley four-valve shaft governor engine. On the reverse side are a few remarks. This engine is built by the Lane & Bodley Co., Cincinnati, O.

A HANDSOME CATALOG which tells about the steel ammonia fittings and ice factory supplies made by the Triumph Ice Machine Co., Cincinnati, O., has been received. As the list of supplies is quite large and illustrations numerous, this catalog contains over 80 pages.

A FOLDER describing and illustrating “Hi-steam” metallic packing has been handed us. It is claimed that this packing will stand any degree of superheat and that its melting point is 1,800 degrees F. It is manufactured by the Steel Mill Packing Co., Hammond building, Detroit, Mich.

“REASONS Why Browning Motors and Dynamos are the Best” is the title of a folder being sent out by the Northwestern Mfg. Co., Milwaukee, Wis. This also contains a table showing the safe carrying capacity of wires as approved by the National Board of Fire Underwriters.

A VERY INTERESTING CATALOG is No. 73 issued by the Ingersoll-Sergeant Drill Co., 11 Broadway, New York. It describes thoroughly the method of lifting water by compressed air with the Pohle system. The catalog is profusely illustrated and will appeal to every engineer.

TWO CIRCULARS descriptive of the Diamond flue blower have been sent us by the manufacturers, the Power Specialty Co., Detroit, Mich. According to the statements of the manufacturers, this blower is being largely purchased by marine and railroad companies. It is also adapted to stationary work.

THE CATALOG of the Hartford Blower Co., Hartford, Conn., besides describing their patent adjustable, interchangeable and reversable blowers and exhausters, contains several tables of interest and value. One of these gives the number of square inches in circles of from 1 to 60 inches in diameter.

“WEBSTER SPECIALTIES” is a handsomely printed folder issued by Warren Webster & Co., Camden, N. J. This deals briefly with their different types of feedwater heaters and purifiers, and separators as well as different patented specialties which are used with the Webster system of steam heating.

SEVERAL CIRCULARS describing and illustrating the different types of Morehead automatic steam traps and the manner of their use, have been received. The Morehead is a tilting trap and has some unique features of construction. It is manufactured by the Morehead Mfg. Co., 75 Buhl block, Detroit, Mich.

“STILWELL HEATERS” is the title of catalog No. 62 issued by the Platt Iron Works Co., Dayton, O. It is a very handsome catalog, being printed on a highly finished book paper. This company also make air compressors, condensing apparatus, Victor turbine water wheels, as well as a full line of Smith-Vaile pumping machinery.

A LARGE FOLDED card upon which is printed a picture of the new 22-story office building of the United States Express Co., which is being erected in New York, has been received from the Jos. Dixon Crucible Co., Jersey City, N. J. As fast as it is put in place the steel work of this building is being protected by Dixon's Silica-Graphite paint.

BULLETIN NO. [illegible], has been issued by the David Bell Engineering Co., Buffalo, N. Y., shows their complete line of "Standard grade" steam hammers. During the last few months this company have sold quite a large number of their hammers to the United States government, some of which will be used at the Panama Canal. More information will be furnished upon request.

THE HISTORY of flange joint packing has been, of necessity, closely identified with and influenced by that of all steam service. As the temperatures and pressures have increased, the earlier forms of flange gaskets have become less and less efficient, necessitating continual improvements to meet the severity of modern requirements. The advantages of asbestos for this purpose are described in a pamphlet "Flange Joint Gaskets" issued by H. W. Johns-Manville Co., 100 William street, New York. The pamphlet is well printed and illustrated and contains a very complete list of sizes and prices.

BULLETIN NO. 72, entitled "Mechanical Draft, What it is, What it Does," has just been issued by B. F. Sturtevant Co., of Boston, Mass. This booklet not only briefly presents the salient features of this system of draft production, but illustrates a variety of plants which clearly show "what it is." The suggested query in the words "what it does" is answered thus: It does what an ordinary chimney is incapable of doing. Its cost is from 24 to 40 per cent of that of a chimney; its intensity permits of the burning of finely divided or low grade fuel; it makes possible the utilization of the heat of the flue gases which a chimney wastes in producing draft; it is independent of the weather; is automatically regulated to maintain constant steam pressure, decreases smoke, increases the capacity of an existing plant, and serves as an auxiliary to a chimney already overburdened; saves space and is portable.

WE HAVE RECEIVED a catalog describing the different types of gasoline motor cars manufactured by Fairbanks, Morse & Co., Chicago. Early in the summer of this year Mr. Geo. H. Webb, chief engineer, Michigan Central R. R. made an inspection trip over the system with one of these cars, and below is some data which is of special interest, showing as it does, what has been actually accomplished with the gasoline motor. Total distance traveled by the cars was 4,347 miles and the total amount of gasoline used was 231 gallons, or an average of 19.7 miles per gallon of gasoline. The records show that on the run from Jackson to Allegan, a distance of 175 miles round trip only 7½ gallons of gasoline were used, or 23.3 miles per gallon. The total cost per mile including lubricating oil, battery cells and everything excepting wages of man in charge was 9-10 of a cent. Most any railroad man can figure out that this is quite a saving as compared with a steam locomotive pulling a private car. This gasoline car has its advantages also because of its ability to attain high rate of speed and maintain it on a long run. From Marshall to Allegan, 66.4 miles, the distance was made in one hour and forty minutes, or at the rate of 40 miles per hour, and they report they never stopped the engine once. The distance from Tekonsha to Harris—29 miles—was made in 45 minutes, and the best run of the entire trip was made from South Haven to Kalamazoo, a distance of 39.6 miles in 45 minutes, or at the rate of 52.94 miles per hour. The manufacturers report that there is a large demand for cars of this class now that they have demonstrated that they are a complete success, and their factory with the present facilities is not able to keep up with the orders which are received from all sections of the country.

TRADE NOTES.

MR. C. S. POWELL, general agent of the Westinghouse Electric & Mfg. Co., who has for some time occupied offices at 11 Pine street, New York, has removed to the offices of the company on the 10th floor of the Trinity building, 111 Broadway. The Westinghouse Electric & Mfg. Co., in addition to their offices in the Hanover building at 11 Pine street, occupy the entire 10th floor of the Trinity building.

CHANDLER & TAYLOR CO., Indianapolis, Ind., report the following recent sales: Three engines for the Michigan Agricultural College, Lansing, Mich. These engines are of their standard enclosed self-oiling type, two of 100-kilowatt and one of 50 kilowatt capacity. These are to be direct connected to Bullock generators. Another engine of thi was sold the N. Auth Provision Co., Washington, D. (three more to the Sisters of Providence, a charitable i tion, at St. Marys, Ind.

ENGINEERS WHO HAVE tested Albany grea said to willingly admit its effectiveness on either slow running machinery, and claim it is the ideal lubricant in warm or cold weather. Messrs. Adam Cook's Sons, 31 street, New York city, are constantly reminded of this ters which reach them from various points. In a recen munication from T. J. Hall, proprietor of the Point Pl Mills, Eminence, Ky., the writer states, "I did not know a cool bearing was until I used Albany grease."

THE FOOS GAS ENGINE, manufactured by the Gas Engine Co. of Springfield, Ohio, received a gold at the Lewis-Clark Exposition at Portland, which just It is said that the Foos engine has taken medals at expositions where it has been shown and the company us that they have received many first prizes at various fairs this fall. The popularity of this engine is such th facilities of their plant are overtaxed to fill their although they have the largest exclusive gas engine f in the country. A further addition to the plant is now consideration.

OWING TO THE RAPIDLY increasing southern of the past year the De La Vergne Machine Co. of have established a branch agency at Atlanta, Ga. We stand this agency is to cover the states of North South Carolina, Alabama, Florida and Georgia handle business connected with the three lines of chinery manufactured by the De La Vergne Machine Co refrigerating and ice making machinery, Hornsby-Akro engines and Koerting gas engines. Their representativ be Mr. W. M. Hargreaves, and the office will be located Candler building.

MATERIAL INCREASE from month to month i sale of White Star oil filters by the Pittsburgh Gage & ply Co., Pittsburg, Pa., indicates plainly the tendency times toward adoption of a simple, cheap and effective for reducing oil bills and improving lubrication. Power large and small, the country over, are buyers of White filters. The following concerns are among recent purch Wabash Clay Co., Veedersburg, Ind.; Lalance & Gro Mfg. Co., Harrisburg, Pa.; Campbell & Wright, Tus Ala.; Gilmore & Davis Co., Tallahassee, Fla.; Driggs bury Ordinance Corporation, Sharon, Pa., and Schm Brewing Co., Wheeling, W. Va.

IN A COMPETITIVE TEST in one of the largest in the west, to determine the actual variation of pressure the use of pump governors on a large duplex tandem pound pump of 3,000,000 gallons capacity, the one showed the least variation, it is said, was the Wil governor, which is manufactured by the Williams Gauge Pittsburg, Pa. This governor maintained the pressure pump with an actual variation of less than two pounds. others, which were tested, would not operate under thre one-half to six pounds variation. This governor is also by the United States government, where it was selected numerous tests. The Williams Gauge Co. have opene office at 311 Hermen building, New Orleans, La. Mr. Ch Smith is in charge.

AS OUR READERS doubtless know, the busine the B. F. Sturtevant Co., Boston, Mass., was primari manufacture of blowers. This naturally led the busines various allied branches, such as the building of heating, lating and mechanical draft apparatus, etc., as well manufacture of engines and motors to operate the blo and later of generators for use in connection with the e for electric lighting both in stationary power plants marine service. More recently have been added the facture of economizers, exhaust heads, etc. These products are distinctly different in character, some such as can be readily manufactured on the intercha plan, while others like heating, ventilating a draft apparatus, must each be built to meet each individual customer. Such apparatus is, h made up of standard machines by the assem sizes of engines, motors, blowers, etc., as may meet the requirements, the special work thus co in sheet metal work, the piping, framing, etc., sary in each case.

BOILER SCALE vs. YOUR SALARY.

rhaps you think that there is little or no connection tween the two, but is it not a fact that the engineer who eps his boilers free from scale reduces the operating penses of his plant? The engineer who can do this and es it is worth more to his employer than the man who esn't.

INTERNATIONAL BOILER COMPOUND

ll remove scale and keep the boiler in excellent condi-n. We have a proposition that will interest every gineer. ***Write for it.***

ERNATIONAL BOILER COMPOUND CO., 47 Market Street, CHICAGO.

Columbus Gasoline Engines

ATIONARY, HOISTING, PUMPING AND R COMPRESSERS. Send for catalog 26

Columbus Machine Co
Columbus, Ohio

Belt in Marion Stove Company, Marion, Ind. Gandy 12" belt, 11' centers, from 72" to 42" pulleys. 200 r. p. m. 17" slack. Cling-Surface used two years.

Cling-
Surface and a Gandy Belt

CLING-SURFACE is just as good for Gandy, Leviathan and other painted or unpainted cotton belts, as for leather belts.

It penetrates into them, keeps them pliable, preserved, prevents any cracking, stops all slip, so that they can all be run easy or slack, carry full loads and give perfect service.

Order Cling-Surface on trial. Results guaranteed.

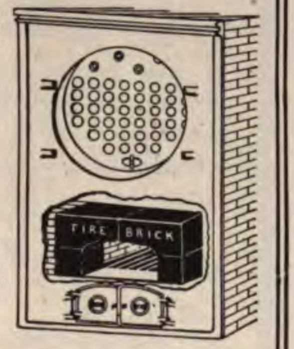
CLING-SURFACE CO
154-160 VIRGINIA ST BUFFALO N Y

IRE BRICK

Boiler Door
Arch and
Jambs

ite for Catalogue and Prices,

ESBREY FIRE BRICK WORKS
208 Somerset Ave.
TAUNTON, MASS.



NUGENT'S

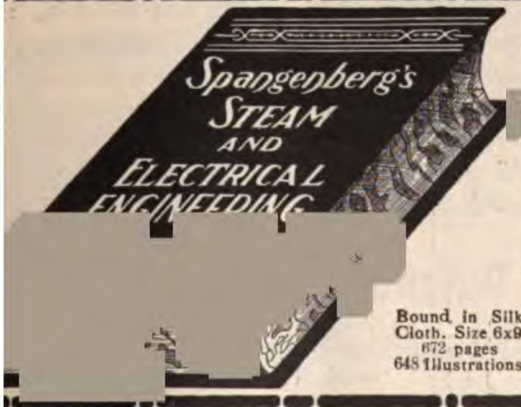
Catalogue of new and up-to-date Oiling Devices and Valuable Treatise on

"How to Oil an Engine"

will be sent free of charge upon request

It contains a lot of good pointers.

WM. W. NUGENT & CO.
Canal & Randolph Sts. Chicago, Ill.



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672 pages
648 Illustrations

As a Practical Book for Practical Men Spangenberg's Book Ranks First

All the engineering information you should have; all you really need is contained in this book in plain, practical and concise form

Spangenberg's Steam and Electrical Engineering

is a complete library covering the subject in all its various branches and contains 672 pages. The only book ever published containing 1035 questions and answers. Written so you can understand it. $3.50 is the price, and it is sold with the understanding that it may be returned if not satisfactory, and your money will be refunded immediately. Out of 10,000 books sold only two have been returned. This fact speaks for itself. CUT OUT AND MAIL TODAY.

GEO. A. ZELLER BOOK COMPANY, 90 S. Fourth Street, St. Louis, Mo.

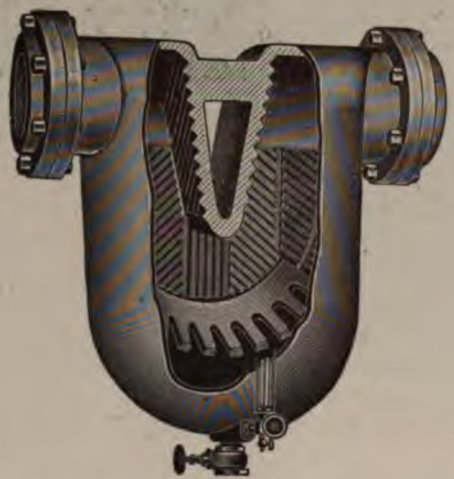
I accept your offer to send me, express prepaid, one of *Spangenberg's Steam and Electrical Engineering*, price $3.50, and enclose $2 as first payment. The balance, $1.50, I agree to remit in 50c monthly installments, money or express order or stamps.

Name..

Street or Box No...

City and State...

How Can Water or Oil Possibly Get Through this Separator with the Steam?



AUSTIN FIGURE "B" HORIZONTAL PATTERN.

The steam may pass through it in either direction—the result will be the same.

Absolutely perfect separation of water from live steam, or of oil and impurities from exhaust.

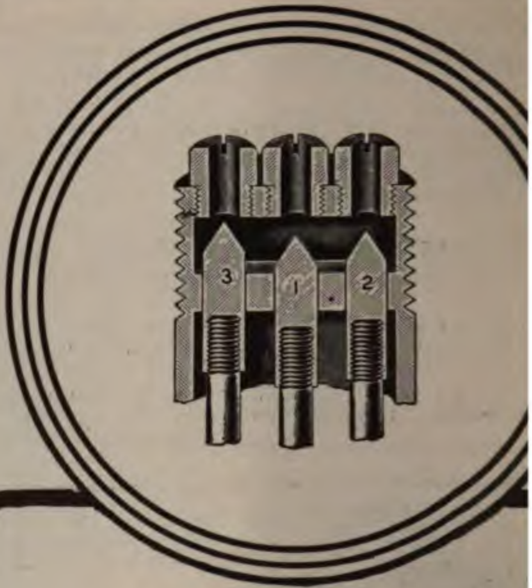
Looking at the design of this Separator will show you that it will do good work.

But there is a reason under the surface for its efficient operation—

The baffle plates are set at an angle that causes the steam to rebound at an opposite angle. This sets up a centrifugal action that impinges all water or impurities against the corrugated sides, whence they are drained down into the receiving chamber and then out through the drain pipe.

Perfect separation is a matter of certainty—not guesswork—and we let you prove it before buying. Ask for Catalogue 15, just issued, detailing all styles of Austin Separators.

Austin Separator Co.
90 Woodbridge Street,
Detroit, Mich., U. S. A.

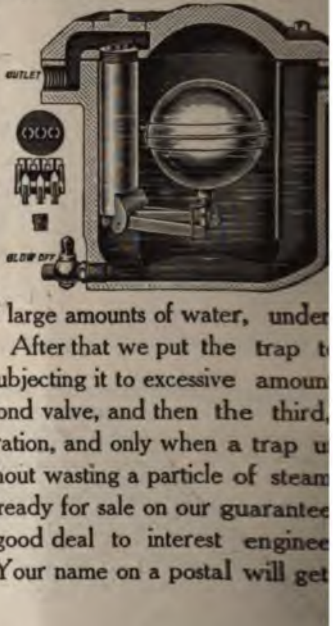


The "Valve-Rightnes of a Wright Steam Tra

Admittedly, the most important part of a trap is the valve arrangement.

If that goes wrong the entire trap goes

In the construction of our "Emergency"



we make sure of the valves above everything else before a trap leaves our factory.

They must test perfectly. The first valve must take care of large amounts of water, under ferent pressures. After that we put the trap emergency test, subjecting it to excessive amoun water. The second valve, and then the third, brought into operation, and only when a trap goes this test without wasting a particle of stean we pronounce it ready for sale on our guarante

There is a good deal to interest enginee our catalogue. Your name on a postal will get a copy.

Wright Manufacturing C
82 Woodbridge St., Detroit, Mich., U.

The Standard Steam Trap of America

IS THE

NDERSON

MANUFACTURED BY

THE V. D. ANDERSON CO.

CLEVELAND, OHIO.

The COOKSON Steam Trap

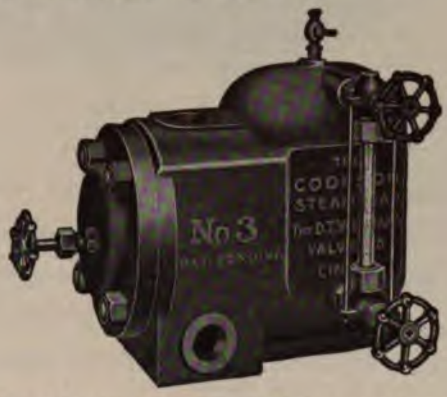
has many advantages which are claimed but not proven by others. It is the simplest trap on the market.

COOKSON traps and parts are interchangeable.

Any trap can be taken apart in 10 minutes without breaking pipe connections.

It can be converted into either a high or low pressure trap by simply changing the valve and seat.

It is guaranteed for one year.



We will be glad to send any literature to any one interested or we will furnish one on trial to responsible parties.

The D. T. WILLIAMS VALVE CO.

Cincinnati, Ohio.

We also make Valves for all purposes. Get our Catalog.

team Traps Save Coal

RETURN STEAM TRAP

This company manufacture Steam Traps for all duties. Return Steam Traps for returning the water of condensation back into the boiler under pressure, without the aid of a pump, and non-return steam traps for discharging the water into a tank or atmosphere and preventing the escape of steam from the system.

SEND FOR CATALOGUE "S"

The Albany Steam Trap Co.

Albany, N. Y., U. S. A.

Established 1871.

Fred'k Townsend, Pres.

Jas. H. Blessing, Gen. Mgr.

The Reliance Steam Trap

PERFORMS ITS DUTY ALL THE TIME.

When it comes to you it is fit and ready.

Connect it up, set it at work and forget it. It needs no attention, no tinkering, no fussing with. There's nothing about it to get "out of whack" and it will last practically forever.

You might be interested in the catalogue.

The Reliance Gauge Column Co.

86 E. Prospect Street,

CLEVELAND, OHIO.

The simplest and most efficient trap on the market today is the Golden Tilting Steam Trap

It is positive, perfect in action

It has no floats, valves or buckets to get out of order

All working parts are on the outside. If you need a new trap investigate the Golden.

THE ANDERSON CUSHIONED NON-RETURN VALVE

is a safeguard where high steam pressure is used. It will automatically cut off the steam in case of accident to the boiler; also acts as a safety stop to prevent steam from being turned into a cold boiler

Worth Has Won

Absolutely no possibility of chattering or hammering

Every up-to-date engineer should be familiar with this valve and other Anderson valves. They are described in our catalog.

SEND FOR DESCRIPTION OF OUR OTHER SPECIALTIES

Golden-Anderson Valve Specialty Co. 200 Pike St., Pittsburg, Pa.

PROMINENT ENGINE BUILDERS WHO USE OUR FILTERS

The following list contains the names of some of our customers among the leading builders of engines of all types. No higher endorsement of our goods could be mentioned than the patronage of these concerns, as they are necessarily in close touch with the most advanced engineering practice, and in many cases their officers are among the leading engineers of the country:

Allis-Chalmers Co.	Chicago, Illinois
American Engine Co.	Bound Brook, New Jersey
A. L. Ide & Sons	Springfield, Illinois
Ball & Wood Co	New York City
Bates Machine Co	Joliet, Illinois
Bessemer Gas Engine Co	Grove City, Pennsylvania
Brown Corliss Engine Co	Corliss, Wisconsin
Buckeye Engine Co	Salem, Ohio
C. & G. Cooper Co	Mt. Vernon, Ohio
Charter Gas Engine Co	Sterling, Illinois
De La Vergne Refrig. Machine Co	New York City
Erie Engine Works	Erie, Pennsylvania
Fairbanks, Morse & Co	Chicago, Illinois
Fitchburg Steam Engine Co	Fitchburg, Massachusetts
Foos Gas Engine Co	Springfield, Ohio
Harrisburg Foundry & Machine Works	Harrisburg, Pennsylvania
Hoovens, Owens & Rentschler Co	Hamilton, Ohio
International Power Co	Providence, Rhode Island
Mackintosh, Hemphill & Co	Pittsburg, Pennsylvania
Murray Iron Works Co	Burlington, Iowa
Nagle Engine and Boiler Works	Erie, Pennsylvania
New Era Gas Engine Co	Dayton, Ohio
Olds Motor Works	Detroit, Michigan
Otto Gas Engine Works	Philadelphia, Pennsylvania
Power and Mining Machinery Co	Cudahy, Wisconsin
Providence Engineering Co	Providence, Rhode Island
Putnam Machine Co	Fitchburg, Massachusetts
Ridgway Dynamo and Engine Co	Ridgway, Pennsylvania
Russell Engine Co	Massillon, Ohio
Springfield Gas Engine Co	Springfield, Ohio
Struthers-Wells Co.	Warren, Pennsylvania
The De Laval Steam Turbine Co	Trenton, New Jersey
The Filer & Stowell Co	Milwaukee, Wisconsin
Vilter Manufacturing Co	Milwaukee, Wisconsin
Watertown Steam Engine Co	Watertown, New York
Weber Gas & Gasoline Engine Co	Kansas City, Missouri
Wellman-Seaver-Morgan Engineering Co	Cleveland, Ohio
Westinghouse Machine Co	Pittsburg, Pennsylvania
William A. Harris Steam Engine Co	Providence, Rhode Island
William Tod & Co	Youngstown, Ohio

We send our Filters on thirty days' trial, subject to your approval.

THE USE OF A BURT EXHAUST HEAD

is the best and surest means of removing water and oil from your exhaust steam.

It contains no baffle plates, no diaphragm, no scrap metal—which means the avoidance of friction and insures durability. Built of extra heavy iron, lapped, riveted and soldered. No stronger construction is possible.

Sent on 30 Days' Trial, Subject to Approval

Your name and the word "send" brings our new 48-page catalogue, which should be in the hands of every engineer.

THE BURT MFG. CO.,

Largest Manufacturers of Oil Filters in the World.

228 Main Street, AKRON, OHIO, U. S. A.

VACUUM OILS

Are known and used in every corner of the world where machinery runs. They are the standards of value throughout the whole world; they lubricate every kind of machinery; not the same oil for all machines, but the right oil for each class.

They are made to fit every condition and are used everywhere because they are the best.

Once used VACUUM OILS are always used.

These oils are made at Rochester and Olean, N. Y., and are distributed throughout the world from local branches.

Abroad they are distributed from ***one hundred and twelve foreign warehouses*** and at home they are sold in every city.

VACUUM OILS

reduce friction to the limit, thus saving power. They are always uniform; can always be depended upon. They do their work better than other oils and cost less when the amount of work done is considered.

VACUUM OIL COMPANY

ROCHESTER, N. Y.

Attractive

THE SWARTWOUT EXHAUST HEAD

is a consideration in the purchase of an exhaust head. Durability is essential. Simplicity of construction, thoroughness of operation and attractive design are all combined in

The Swartwout
cast iron
Exhaust Head

This Exhaust Head is one of the big improvements of the generation. It works on the easily understood principle of centrifugal force, and because of its extreme simplicity is thorough and practical.

Particulars worth having—
You should write us to-day—
NOW.
Costs you nothing to get posted.

THE
HIO BLOWER [redacted]
3-45 MICHIGAN S
LEVELAND [redacted] U.S.A.

HARRI[redacted] OILS

Oils that lubricate, owe their value as lubricants to their successful establishment, between friction surfaces, of a durable film of mobile, globular oil molecules.

The cohesiveness of these oils enables them to withstand the heavy pressure to which they are subjected between close fitting surfaces, without being squeezed out.

To its possession of these qualities, together with its freedom from acids, elements that gum and destructive grit, the efficiency of ***Harris Engine Oil*** is ascribed by those who know.

In ***Harris Valve Oils,*** these properties are combined with the faculty of mixing with steam and adhering to surfaces and of retaining their cohesiveness under the influence of high temperature, that make them the best lubricants in existence for the internal working parts of engines.

We have a plan, good for engine, engineer and owners, by which we prove the value of our oils in comparison with any you are using.

A. W. HARRIS OIL COMPANY
321 South Water Street,
PROVIDENCE, R. I.

Tatum & Bowen, 36 Fremont St., San Francisco.
Pacific Coast Agents.

THE WHITE STAR OIL FILTER

pays 100 per cent quarterly dividends.

It thoroughly purifies dirty lubricating oil, rendering every dollar's worth fit for use over and over again.

It is a necessity in every power plant, a paying investment from the start. Unlike any other Filter it can be quickly taken apart and cleaned.

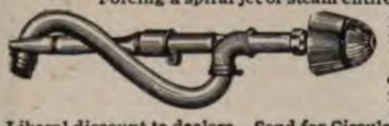
Vital facts pertaining to the purification of dirty lubricating oil, results attained by the White Star, also list of prominent users are shown in Booklet "J" which we will be pleased to mail you.

Pittsburgh Gage & Supply Co.
PITTSBURGH, PA.

OIL FILTRATION EXPERTS.

Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.

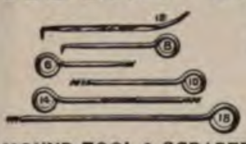


Sizes to fit any boiler, with 1-in. to 16-in. tubes. A & D. Patent.

The old reliable and most economical cleaner in the market. It has no equal. Satisfaction guaranteed.

Liberal discount to dealers. Send for Circular and Price List of Cleaner and Hose. Room 13, 74 Frankfort Street, CLEVELAND, OHIO.

MOUND PACKING TOOLS



Will go in any valve, rod pump or engine stuffing box. Will withstand roughest usage.

1 set of 4 Locking Tools.....$1.50
1 set of 6 Packing Tools..... 2 25
1 set of 5 Cold Chisels......... 2.00

Mail orders promptly attended to. Get our book Engineers' Chums.

MOUND TOOL & SCRAPER CO., 710-712 Howard St., ST. LOUIS, MO.

"Lightning Tube Cleaner" Features

1—Cleans scaled tubes inside or outside.
2—Propelled by water, air or steam.
3—Does the work quick.
4—Saves $2.00 every 10 hours run metered water bill.
5—Motor Wheel utilizes a compound power.
6—Construction overcomes cone and ball breakage.
7—Has re-sharpening, non-breakable cleaner head.
8—Future repairs, very small item.
9—Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

Sold on approval. Attractive proposition to State Agents.

MAURER, LABADIE & CO.
215 St. Joe Street, South Bend, Ind.

TRY IT

THAT IS OUR ARGUMENT

If you don't find that

RUGGLES PERFECTION FLUE CLEANER

is the simplest and most efficient cleaner on the market—SEND IT BACK. We will send it to any responsible party for a free 30 days' trial . . .

RUGGLES & RUGGLES
BATAVIA, ILL.

Weinland Tube Cleaner

You know as well as we do that scale in the boiler tubes puts exclamation points on the coal bills. Perhaps you don't know as well as we do how easy and cheap it is to get out any quantity of any kind of scale with the Weinland Tube Cleaner.

We've spent 20 years studying conditions, perfecting Turbine and Power Cleaners. Our knowledge and experience are at your service.

We often make special cleaners for special cases.

A postal from you will bring our printed matter; a special representative if you wish, or a cleaner on approval.

Ask us also about **The Lagonda Damper Regulator, Tube Cutter** and **Reseating Machine.** All money savers.

The Lagonda Mfg. Co.

Philadelphia
Chicago
London, Eng.

Springfield, Ohio.

New York
Pittsburg
St. Louis

Reg. U. S. Pat. Off.

This Trade mark
on every package

There is only ONE ALBANY GREASE

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Can be used in every style of grease cup made, which cannot be done with *any other* lubricant.

Cost of using Oils
Cost of using ALBANY GREASE

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

Buying Lubricants and Supplies on prices without considering quality is not good judgment, it does not pay. We will give you the benefit of our years of experience

ADAM COOK'S SONS,
313 West Street, NEW YORK CITY, U. S. A.

Interesting Facts About Boiler Cleaners

THE "TORPEDO"
Removes all scale from tubes of fire tube boilers
Saves 10% of fuel for each 1/16 inch in thickness of scale
Prolongs life of tubes
Saves compound
Centers itself in tube
Strikes same in every direction
Stroke is limited and economical
Does not hammer but vibrates the tube
Is absolutely safe and easily operated
Has but one moving part
Will last a lifetime
Double Acting Vibrator
Automatic Centering Lugs
Automatic Centering Lugs
Scale
Tube

OPERATED BY WATER
THE "DEMON"
Removes all scale from tubes of water tube boilers
Saves 20% of fuel for each 1/16 inch of scale
Is 42 times as powerful as turbine cleaners
Does not hammer or grind but cuts like lathe tool
Centers itself and cuts same top, bottom & sides
Adjustable cutter stops prevent injury to tubes
Rotary pistons are acted upon by direct pressure as in steam engine
Has roller bearings

The **"Torpedo"** is the outgrowth of years of experience in manufacturing and selling other boiler tube cleaners. It is readily conceded by experts to be as much in advance of its predecessors as the modern locomotive is in advance of the old stage coach.

Why? Because we laid the "hammer" idea on the shelf long since, and substituted the vibration principle.

The Difference? As much difference as night and day. They both remove scale; but the hammer method strains and stretches the thin walls of the tube.

The **"Torpedo,"** the only vibration machine made, makes the tube hum instead, which is harmless to the flue but mighty effective in peeling off the scale.

Notice the centering lugs on the **"Torpedo"** which hold the cleaner "true as a die" in the tube, so the same stroke is made top, bottom, and sides. Take a **"Torpedo"** on free trial and see for yourself. If it isn't the best cleaner in every way that you ever saw, then don't buy it. Write to-day.

Let us tell you how we came to manufacture the **"Demon."** Well, it's like this:

Water tube boilers were becoming more and more in vogue and engineers were "up against it" to get a machine to suit them.

The turbines were weak in rotary force, weak in construction, and slow in operation.

The hammer cleaner hammered the tubes out of shape, clumsy to handle and were not operated by water as they should be.

The outside motor cleaner was very expensive, cumbersome, and discouraging to keep in repair.

No wonder engineers felt like throwing up their jobs with such tools at hand.

One engineer did resign his position and the invention of the **"Demon"** followed.

Really, this is a dandy and we are mighty proud of it.

It is so powerful it will clean a whole tube before other cleaners have cleaned a foot. Besides, it is big and strong and well made. It makes a tube look as if it just arrived from the rolling mill. Don't wait, but take one on free trial and see for yourself.

THE GENERAL SPECIALTY CO., 73 Carroll St., Buffalo, N. Y., U. S. A.

Pumps and Hydraulics
IN TWO PARTS $4 By WILLIAM ROGERS

JUST PUBLISHED

Every Superintendent, Engineer, Power Pump Attendant and Machinist Should Have These Books

It is with unusual pleasure we ask your attention to our recent publication. "ROGERS' PUMPS AND HYDRAULICS" is most complete and practical, treating on the construction, operation, care and management of pumping machinery, the subject of hydraulics being thoroughly described.

This work is illustrated with cuts, diagrams and drawings of work actually constructed and now in operation; the rules and explanations of the principles shown are taken from everyday practice. No expense has been spared in our endeavor to make this a most thorough instructor on the subject. Send postal for our Pump Catalog.

THEO. AUDEL & CO., Publishers, 63 5th Ave., N.Y.

$1 DOWN

Upon receipt of one dollar, and agreement to remit the same amount each month for three months, the set will be shipped to any part of the world with all transportation charges prepaid. This method of purchasing may prove convenient and satisfactory, as it allows the use of the books while the payments are being made.

SHIPPING DIRECTIONS

Date....................................

I enclose $1.00 (one dollar) to apply on first payment on one set of

Rogers' Pumps and Hydraulics $4
(COMPLETE IN 2 PARTS)

which ship at once to the following address, all charges prepaid. I hereby agree to remit by mail at the rate of one dollar each month, the remaining three dollars.

Signature ....
Occupation....................................
Where Employed....................................
Residence ....
City.................................... E.R.

Classified Index for Buyers.

For addresses of manufacturers refer to the Alphabetical Index on page 49 which gives the pages on which the advertisements appear.

Air Compressors
Quincy Engine Works
Snider-Hughes Co.

Air Compressors, Gasoline
Columbus Machine Co.

Alarms, High and Low Water
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Reliance Gauge Column Co.
Wright Mfg. Co.

Arches and Jambs, Boiler Door
Presbrey Fire Brick Works

Arch Plates, Boiler
Lamprey Co.

Automobile Fittings
Lunkenheimer Co.

Belt Dressing and Filling
Cling-Surface Co.
Dixon Crucible Co., Jos.

Belting
Chicago Rawhide Mfg. Co.
France Packing Co.
Peerless Rubber Mfg. Co.
Quaker City Rubber Co.

Blowers
Ohio Blower Co.
Snider-Hughes Co.

Boiler Compound Feeders
International Boiler Compound Co.

Boiler Door, Arches and Jambs
Presbrey Fire Brick Works

Boilers
Cooper Co., C. & G.
Harrison Safety Boiler Works
Holyoke Steam Boiler Works

Boiler Tube Cleaners, Mechanical
Bushnell & Co., John S.
General Specialty Co.
Lagonda Mfg. Co.
Liberty Mfg. Co.
Maurer, Labadie & Co.
Pierce Co., Wm. B.

Books
Audel & Co., Theo.
Engineers' Review Co.
Zeller Book Co., Geo. A.

Boring Machines, Electric
McCrea & Co., Jas.

Brass Founders
Lunkenheimer Co.
Williams Valve Co., D. T.

Brick, Fire
Presbrey Fire Brick Works

Calipers
Starrett Co., L. S.

Castings, Brass
Lunkenheimer Co.
Pittsburg Gage & Supply Co.

Chemicals
Lord Co., Geo. W.

Clamps, Pipe
McCrea & Co., Jas.

Clamps, Steam Joint
McCrea & Co., Jas.

Cocks
Lunkenheimer Co.
Penberthy Injector Co.
Pittsburg Gage & Supply Co.
Powell Co., Wm.
Reliance Gauge Column Co.

Cocks, Gas
Lunkenheimer Co.
Pittsburg Gage & Supply Co.

Coils and Bends, Iron, Brass or Copper Pipe
National Pipe Bending Co.

Commutator Lubricants, Graphite
Dixon Crucible Co., Jos.

Compounds, Boiler
International Boiler Compound Co.
Lord Co., Geo. W.

Compounds, Car Axle
Lubron Mfg. Co.

Compounds, Graphite Pipe Joint
Dixon Crucible Co., Jos.

Compounds, Lubricating
Keystone Lubricating Co.

Condensers
Snider-Hughes Co.
Stewart Heater Co.
Wheeler Condenser & Eng. Co.

Conveying Machinery
Borden & Selleck Co.

Cooling Towers
Wheeler Condenser & Eng. Co.

Counter Shafts
Myers & Bro., F. E.

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(Continued on page 5)

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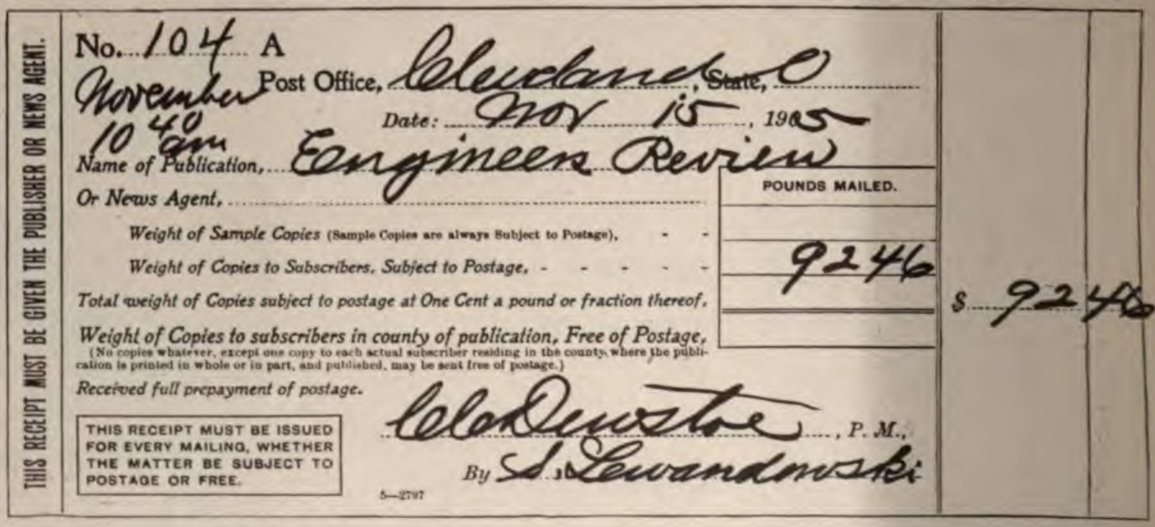

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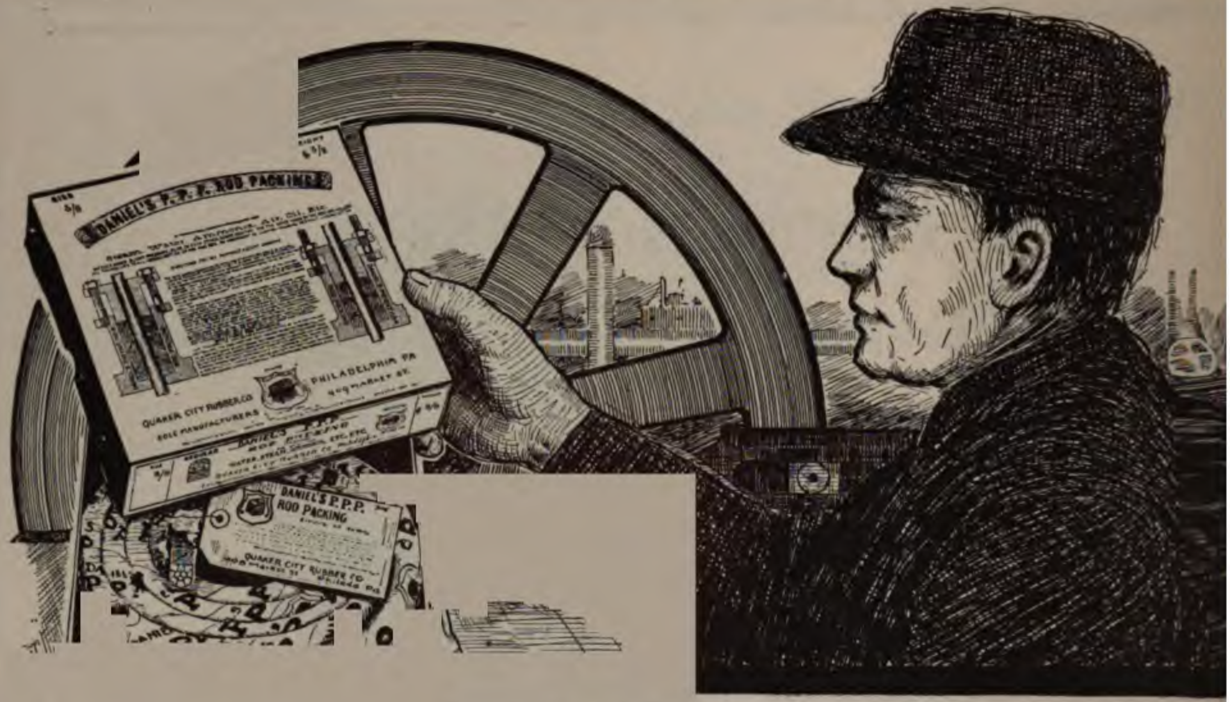
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ued from page 56)

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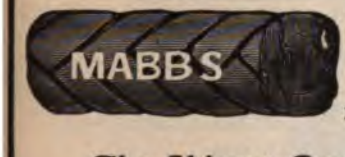

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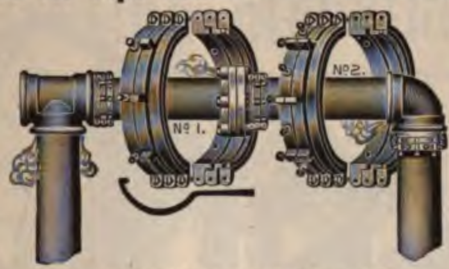

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is that kind of a heater. It has straight seamless, drawn brass tubes tested to 700 pounds per square inch.

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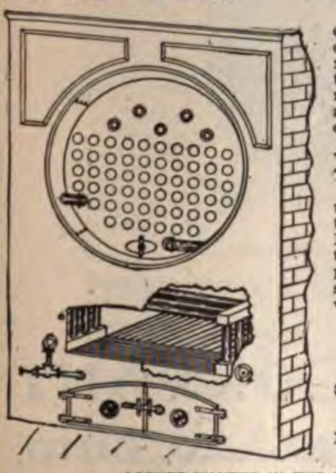

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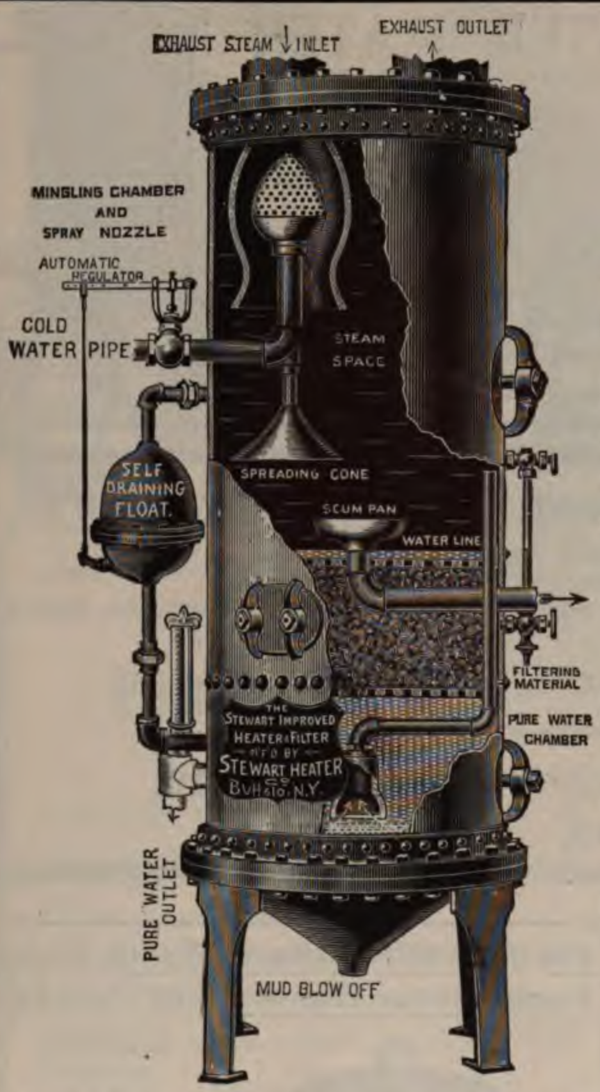

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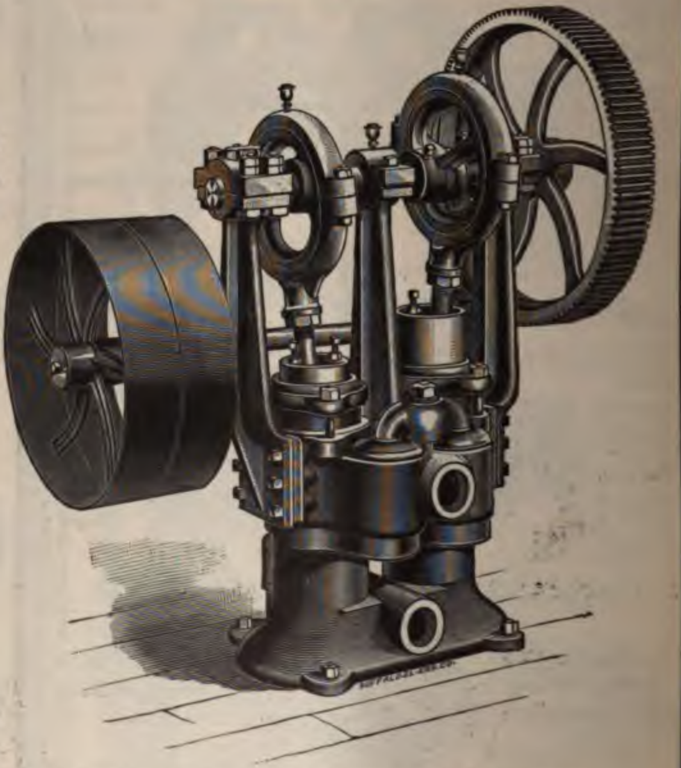

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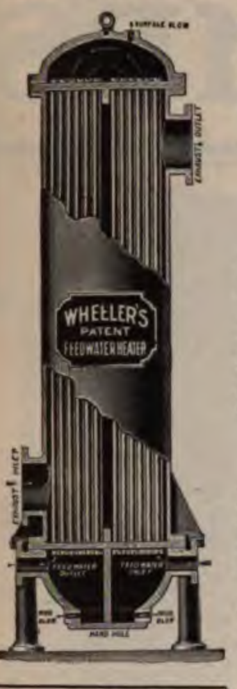

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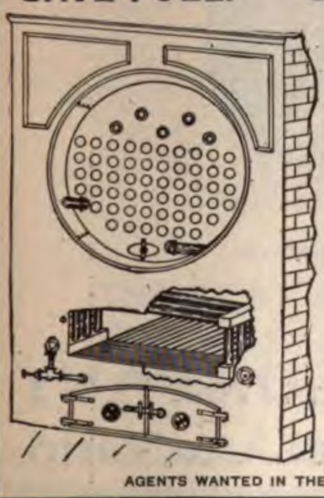

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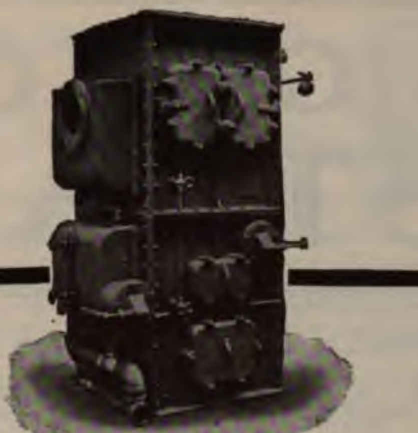

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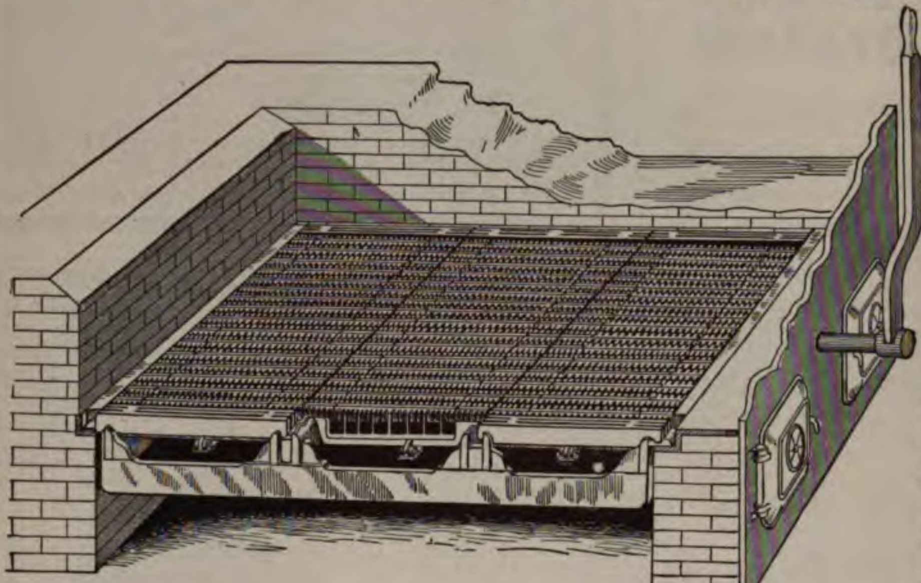

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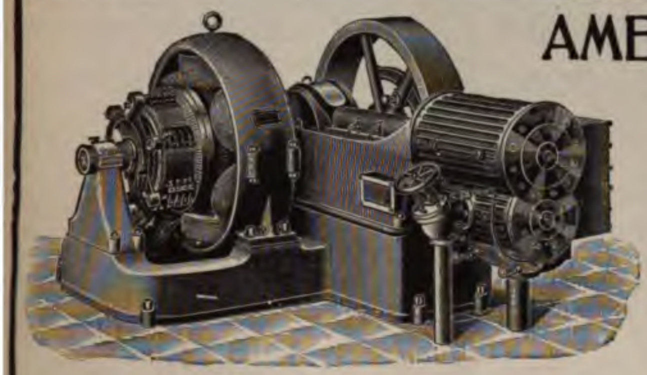

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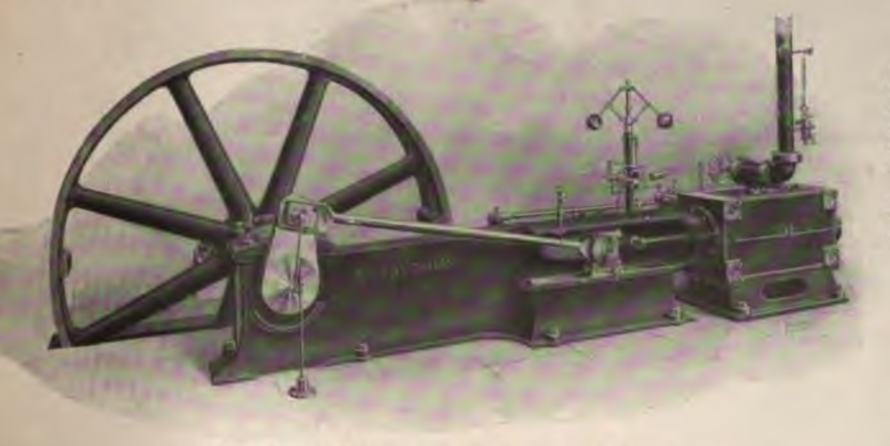

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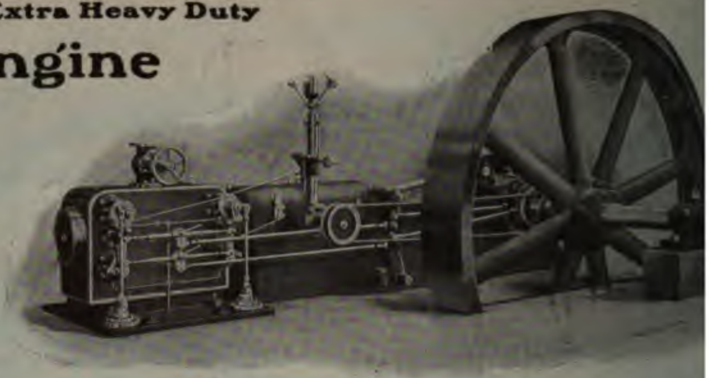

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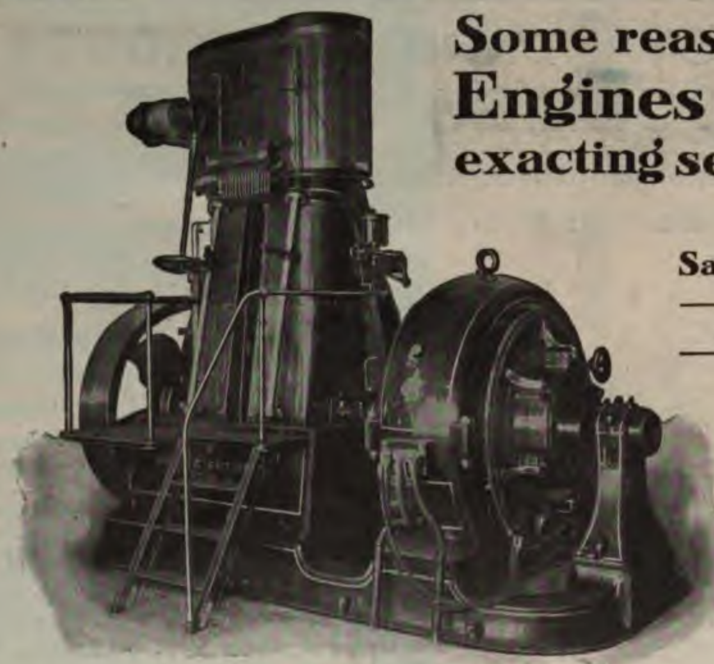

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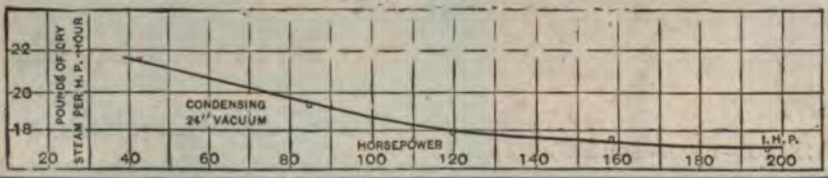

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An Engineer's Cap.

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KEYSTONE GREASE reduces friction, cools bearings and keeps them cool, is las ingly durable in tight or loose bearings, with light or heavy, fast or slow shafting. Wor equally well at any temperature, and does not deteriorate by keeping.

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ENGINEERS' REVIEW
FOR STATIONARY ENGINEERS
ol. 16. CLEVELAND, JANUARY, 1906. No. 11.

OST OF THE CONCORD MUNICIPAL LIGHT PLANT.

BY W. O. ROGERS.

The town of Concord, Mass., is known throughout ne country as a town of historical interest and the irthplace of many famous men and women. Concord eing noted for its distinguished and wealthy residents, seems strange that up to the year 1899, no steps were aken to make improvements in the matter of residential nd street illumination. Prior to this time the ordinary erosene or gasoline lamps were used for street lighting, vhile the more artistically designed lamps were used for ouse illumination.

An electric lighting committee was appointed in 1889, ut owing to the rapid changes which were taking place n engineering, the committee considered it to be for the est interest of the town to postpone the construction of n electric lighting plant until it could be shown that pparatus installed could be operated for a reasonable ength of time before it became out of date. Today, ix years later, Concord can boast of an electric light lant which is a model in every respect.

When it was decided that a municipal lighting plant vas desirable the matter was placed in the hands of Messrs. Stone and Webster, of Boston, Mass., who undertook the work of making plans and specifications and uperintending the construction of the entire plant.

The matter of managing the lighting plant was placed in the hands of a municipal light board who carefully examined the plans and after due consideration decided to install two, two-phase, alternating current, direct connected generators driven by two 125-horsepower tandem compound condensing engines, supplied from two horizontal return tubular boilers. The power house was so far completed that the machinery and boilers were placed therein about Nov. 1, 1899, and the first current used for street lighting was turned on Feb. 2, 1900, operating on the moonlight schedule.

The plant is located close to the Boston & Maine R. R., southern division, a spur track running to the coal shed which adjoins the boiler house. The coal is then delivered to the boiler room by a coal passer. It is contemplated, however, in the near future to install a coal handling system for delivering coal from the coal shed to the boiler room.

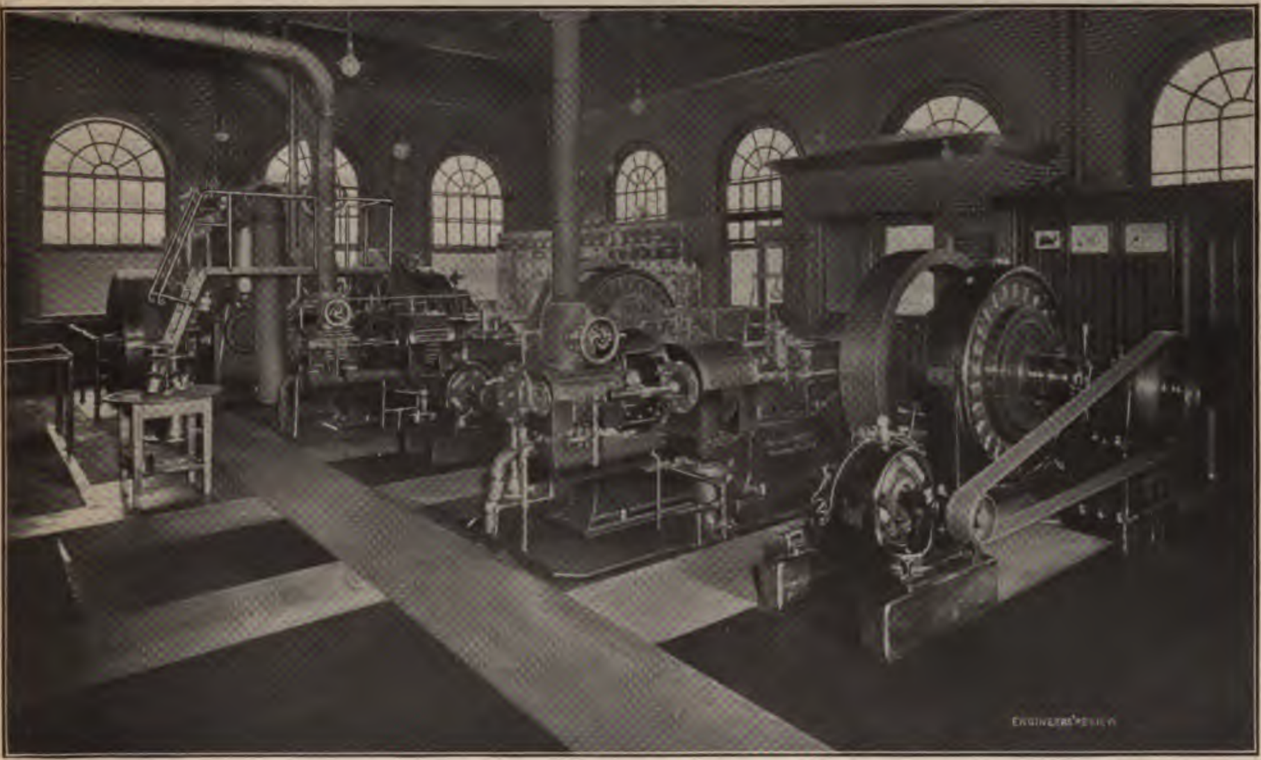


FIG. 1. ENGINE ROOM OF THE CONCORD MUNICIPAL ELECTRIC LIGHT PLANT.

In the boiler room are now located three 60-inch horizontal return tubular boilers, 16 feet long and containing 92, 3-inch tubes. The thickness of the shells is 7-16 inches and the thickness of the heads ½-inch. These boilers carry a pressure of 135 pounds and are rated at 90-horsepower. They are riveted in the following manner. The circumferential seams are lapped and single riveted. The longitudinal seams are secured by the triple riveted butt joint, in which the edges of the plate are brought together end to end, with a covering plate above and below and riveted through the three sheets.

The bracing of the boilers is by means of through bolts running from head to head with two nuts on each end, one inside and one outside of the plate, the heads being stiffened by channel iron bars at the points where the bolts pass through. Diagonal braces are also used. The boilers are of the overhang front, as shown in Fig. 2.

The boilers are suspended from beams, instead of resting upon the brick setting. The inside walls of the setting are lined with one course of fire brick, every fifth being a course of headers, which extends back to the rear of the bridgewall. The side walls close in upon the shell at a point one course of brick below the lugs. The face of the front walls and both the face and top of the bridge wall are lined with one course of fire brick laid as headers. The rear wall of the setting is also lined with one course of fire brick. The brick work surrounding the boiler fronts is constructed of white enamel brick which in contrast with the neatly painted boiler heads presents an attractive appearance.

As shown in the photograph Fig. 2, the uptake from each boiler is connected to the smoke flue which runs to the brick stack. Each boiler is fitted with all the *necessary* appliances required for safety and convenience. The main steam pipe of each extends up 5 feet and connects with a 4-inch horizontal pipe running to a 7-inch header. The connections between the boilers and the horizontal steam pipe and their connections to the header are made by bends having a radius of 20 inches. The steam pipe connections to the engines are also made with easy bends as shown in the illustration Fig. 3. Pipes 4 inches in diameter form the connections between the header and the Harrisburg engines. An 8-inch pipe supplies steam to the Westinghouse engine which is a recent addition to the equipment.

Fig. 3 shows a side elevation of the boilers and engines, the Harrisburg engines showing in dotted lines beneath the heavy lines representing the Westinghouse engine. These two plans show the exhaust and steam piping of the plant. The engine plant originally consisted of two Harrisburg tandem compound engines with 9 and 17 x 12-inch cylinders operating at 300 revolutions and rated at 125 horsepower each. Fig. 1 presents a view of the engine room showing engine units, switchboard, etc. A plan view of the boiler and engine rooms is shown in Fig. 4.

The Harrisburg engines are each direct connected to a 75-kilowatt, 1,100-volt two-phase, compound wound, revolving armature generator. These engines are fitted with synchronizing devices by which the speed of the engines can be adjusted from 10 below to 10 above nor-

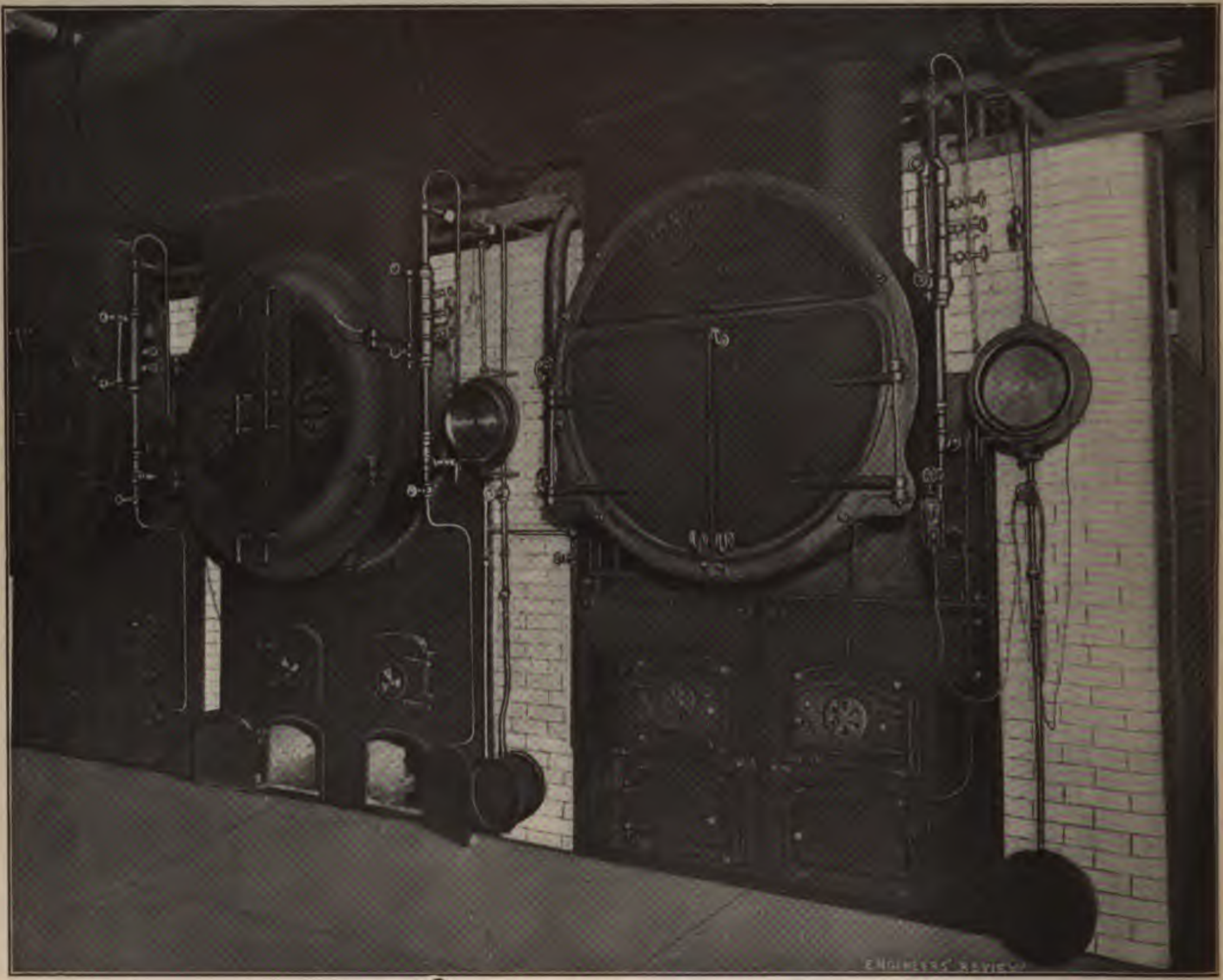


FIG. 2. BOILER ROOM OF THE CONCORD ELECTRIC LIGHT PLANT.

mal speed. This enables the machines to be thrown in multiple where one is loaded and the other running under no load.

The engines are connected to a Knowles jet condenser, the piping being so arranged that either engine may be operated condensing or noncondensing as desired, regardless of the other, or all may be operated condensing at one time. The piping of the condenser is shown in Fig. 5.

In 1902 a contract was entered into with Westinghouse, Church, Kerr & Co. for a 300-horsepower Westinghouse 16 and 27 x 16-inch vertical compound engine, and a Westinghouse 200-kilowatt revolving field, two-phase, 60-cycle generator and exciter, together with a switchboard panel from the Westinghouse Electric & Mfg. Co. A contract was also made with the Hodge Boiler Works for a 90-horsepower horizontal return tubular boiler, which is shown at the right of Fig. 2. This boiler is equipped with a McClave improved grate and Argand steam blower making it possible to burn a cheaper grade of fuel.

The Westinghouse engine is fitted with a synchronizing device which consists of a small direct current motor fitted in the governor wheel, which by means of a worm

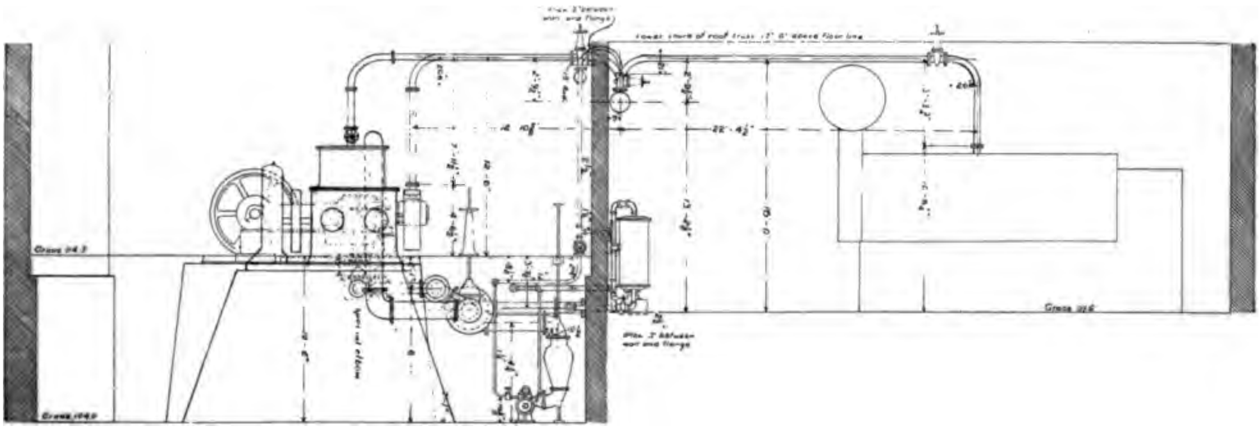


FIG. 3. SIDE ELEVATION OF THE ENGINE AND BOILER ROOMS.

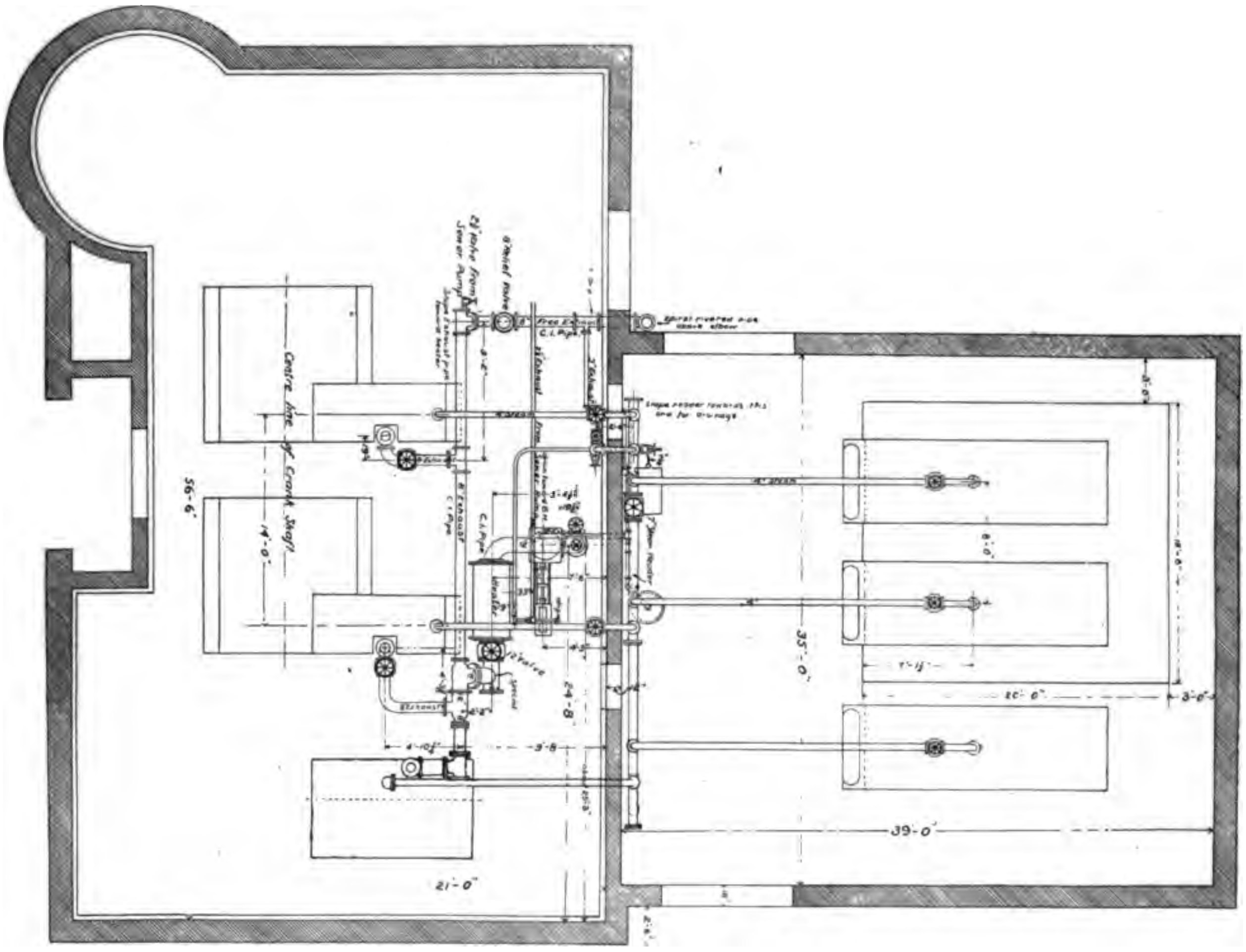


FIG. 4. PLAN OF THE ENGINE AND BOILER ROOMS.

wheel and gear operates the screw in the plug in the governor spring and enables the speed of the engine to be increased or decreased as desired. The motor is controlled from the switchboard and the engineer can bring the machines into synchronism without leaving the board.

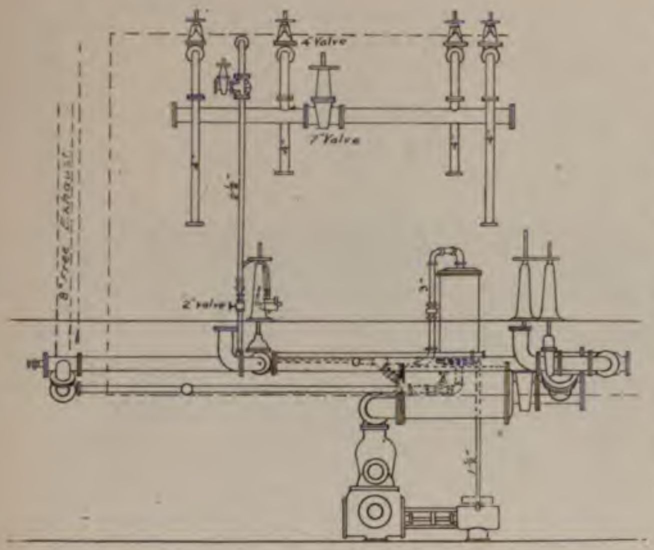


FIG. 5. PIPING OF CONDENSER.

The specifications for the additional apparatus and the plans for the foundation of the new unit were prepared by the manager, Mr. Lee, who is fully capable of doing the work and superintending the erection of the plant.

The engine room is exceedingly light and roomy and is kept in the best possible condition both as regards cleanliness and smoothness of operation. The general appearance of the buildings is shown in Fig. 6, which presents an exterior view of the power station.

Having given a general description of the plant I feel that it would be of considerable interest to engineers if the cost of such an installation were published. The land for the plant cost a total of $3,750.00, the larger portion of the cost being for the grading necessary to bring it to a proper level above the high water mark of the Concord river, flowing nearby. The cost of the building, which is finished in pressed brick with the windows and doors trimmed in granite, was $10,661.76. This includes foundation for the building, foundation for the stack and cost of constructing the stack.

The cost of the three boilers was $5,970.00, the setting for the same amounting to $1,285.00. The piping for the original plant which consisted of two Holyoke steam boilers and two Harrisburg engines was $2,600.00, the new addition necessitating an outlay of $1,800.00 more for piping. The original plans and specifications called for an expenditure of $50,000. The additional plans and specifications, amounting to about $60,000, were drawn and the apparatus installed by Mr. Lee, the manager.

The Harrisburg engines were installed for $3,700.00 and the condenser for $638.50. The cost of the Westinghouse vertical compound engine was $4,978.00, while the Westinghouse electrical apparatus amounted to $3,800.00. The cost of the generators connecting with the Harrisburg engines, switchboard etc., was $13,980, all of which together with a few incidentals brings the *total cost of* installation to $37,752.91, the steam end costing complete $23,180.49 and the electrical end $14,572.42.

The cost of the line construction was approximately $47,697.70. This includes 1,400 poles and 370,000 feet of street lighting wire and 370,000 feet of commercial wire.

There are 38 street circuits. These wires feed 674 25-candlepower incandescent lamps, which together with one circuit which carries six arc lamps are lighting about 35 miles of streets. At the present time there are 348 commercial customers having 11,000, 16-candlepower lamps on the circuits.

The cost of the arc and incandescent lamps amounted to a total of $4,549.17. The cost of the transformers amounted to $3,933.55 and the cost of the meters was $5,178.41.

Tabulating the totals which includes a few miscellaneous items, the amount is as follows:

Real estate	$ 10,661.76
Steam plant	23,180.49
Electric plant	14,572.42
Line equipment	47,697.70
Arc and incandescent lamps	4,549.17
Transformers	3,933.55
Meters	5,178.41
Total	$109,773.50

It can be said without fear of contradiction that this plant will easily rank among the foremost of municipal lighting plants and Mr. Albert W. Lee, manager and electrician, to whom I am greatly indebted for the above information, may well take pride in this electric lighting station which he has brought to its present state of efficiency. Not only this, but a rate of 12 cents per kilowatt hour has been made. The plant has recently instituted a 24-hour service, which under the able management of Mr. Lee bids fair to be a success.

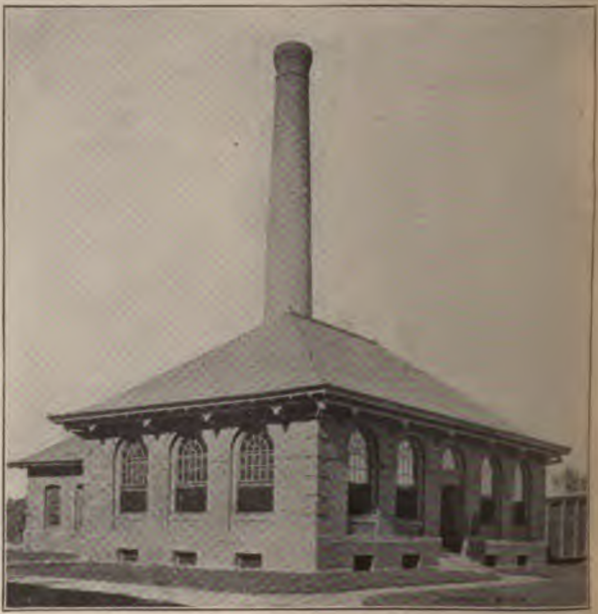


FIG. 6. EXTERIOR VIEW OF THE PLANT.

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into 1 cubic foot of steam (approximately).

EVIEW OF CURRENT LITERATURE ON POWER PLANT ENGINEERING

xplanatory: It is not the purpose of the editors ıake this department an index to current engineering ature. Such an index would be a duplication of rt, another magazine having for some years fur- ed a very good one. The output of articles and ɜrs on steam and power plant engineering has grown ıuch proportions, however, that the busy engineer s the task of keeping in touch with it an impossible

Not only are there twice as many magazines de- d to stationary engineering as one man can well l, but the equally valuable articles published in e than a dozen journals in other fields are practically to him. The aim of the editors of the Engineers' iew is to furnish a digest of the most important ːles on power plant engineering appearing in the ent issues of all technical publications. There is, ourse, a deal of old straw flailing that is interesting necessary, as the graded school is necessary. Every er plant journal furnishes such educational matter ɔst too generously. A survey of the entire field for newest and most helpful results, suggestions and de- pments and the presentation of the things adjudged most essential and helpful in condensed form is ously needed to enable our readers to keep fairly ast of the march of technical progress in their line ork.

/e expect to improve this department as we acquire ɜrience, and we ask the indulgence of readers who ce what they consider omissions and errors of judg- t.

PRIME MOVERS.

ariable Speed Steam Turbine—*Electrical Re- ı, Dec. 2.* A variable speed steam turbine has been nted in England. It is provided with two sets of n admission ports into which steam may be directed ill.

ne side, which gives the higher speed, takes the n through expanding nozzles to the rotor, which ists of two sets of movable blades and one set of l blades. The steam is then exhausted.

ɔr the slower speed the steam is taken through the ː blades, but instead of being exhausted at the same t, it is taken through a channel to another set of es before being exhausted. This gives about ½ d with the same efficiency as full speed.

xhaust Steam Turbine—*Street Railway Journal. 23.* The Philadelphia Transit Co. have recently ılled an 800-kilowatt Curtis low pressure turbine. as also necessary to put in a condenser and cooling ːrs.

ıe turbine proper is provided with four wheels, each pped with a single row of buckets, and takes steam ı the exhaust main at about 1 pound pressure.

ıe exhaust steam from one of the 2,500-horsepower iss engines, when carrying a load of 2,000 amperes, s the turbine an output of 1,300 amperes at 575 , with no increase in back pressure. As about 150 ːres are required for the auxiliaries, the gain from ırbine is from 1,000 to 1,200 amperes or approxi- y 66 2-3 per cent of the output of the original generating unit, instead of the 25 per cent which is usually expected from the introduction of a condenser.

The turbine has a steam consumption of 36 pounds per kilowatt-hour at full load and 40 pounds at half load, with 2 inches absolute back pressure in the condenser.

The Atlantic Turbine—*Engineer, London, Dec. 2.* Under this head appears a very interesting comparison between the turbines of the "Carmania" and the quadruple expansion engines of her sister ship, the "Caronia."

The boilers and auxiliaries of both vessels are of practically the same power and weight.

The turbine has been found trustworthy in all weathers, but its high speed was not desirable on account of the necessary small diameter and pitch of the propeller. Therefore to give the proper vane speed and low number of revolutions, larger turbines were made.

There is practically no saving in space on the Carmania and her turbines weigh more than the quadruple expansion engines of the Caronia. The dominant points in favor of the turbine, however, are the absence of vibration, which is detrimental to the hull, and the absence of large and cumbersome crank shafts, which are easily broken, and hard to replace.

No conclusive results have yet been obtained as to the comparative coal consumption of the turbine vessel. She is, however, capable of an increase in cruising speed above normal, without as large an increase in coal consumption as would be expected in a reciprocating engine.

The Steam Turbine and the Isolated Plant—*American Electrician, Dec.* Recent developments in steam turbine design indicate that a wider field of usefulness has opened to the steam turbine as a prime mover. Although the adoption of turbines in isolated plants has been rather slow in this country, the production of large direct current units makes the outlook for more extended application much improved.

Isolated plant practice covers a large range of service, and the distances of transmission are almost always so short in comparison to those encountered in central station and traction work, that direct current is probably used for the bulk of isolated plant loads at the present time.

This preponderance of direct current equipment naturally demands direct current turbo-generators and until quite recently the difficulties of commutation, balancing and armature construction for high peripheral speeds have proven serious obstacles in the way of direct current turbine practice. The production of gearless units broadens the field and paves the way towards the utilization of those special advantages which particularly recommend the steam turbine to installation where space is limited and loads extremely variable.

Besides the uniform angular velocity and freedom from vibration which characterizes the steam turbine, its operating simplicity, the inexpensive foundation necessary, etc., the regulation of small steam turbines is now well within 2 per cent from no load to full load, which makes it adaptable for office building work where the exacting condition of office lighting can readily be met.

The stimulus recently imparted by the manufacturers to the street railway power house market, to the development of large direct current units will doubtless lead to the extensive use of turbine units in the isolated plant field although the extinction of the reciprocating engine is not in the least probable.

500-Kilowatt Curtis Turbine Test—*Wishart—The Engineer, Dec. 1.* A test made at Ottumwa, Ia., to determine the performance of a steam turbine plant and to ascertain the satisfactoriness, of its operation under ecrtain test conditions was as follows: The turbine was of standard two-stage type having a capacity of 500-kilowatts and was direct connected to a three-phase generator.

Steam was furnished at a pressure of 150 pounds, the quality of the steam being obtained by the use of a Carpenter separating calorimeter connected between the throttle valve and the turbine. Readings were taken every 15 minutes for steam and electrical values. In making the run full load was carried for 13 hours, then half load was put on for one hour, as the cables to the rheostat were overheated, and then an overload of 25 per cent was put on for one hour. The load was run up to 50 per cent above rating for about 25 minutes, but could not be held on account of the overheating of the cables.

In determining the performance of the turbine the guarantee called for 150 pounds steam pressure. When the pressure fell below this value, 1½ per cent was allowed for every 5 pounds, which has been found correct by tests already made. No allowance was made for steam pressures ranging above 150 pounds. After making proper corrections for condenser leakage, the final results obtained were as follows:

Half load—Average barometer pressure, 29.17 inches; average vacuum, 27.46; average initial steam pressure, 154.6 pounds; average quality of steam 98.59 per cent; steam consumption, pounds per kilowatt-hour, 23.814 pounds.

Full load—Average barometer, 29,179; average pressure vacuum 27.193; average initial steam pressure, 141.17 pounds; average quality of steam, 88.59; steam consumption per kilowatt-hour, 22.17 pounds.

Overload, 25 per cent—Average barometer, 29.18; average vacuum, 27.175; average initial pressure, 147; average quality of steam, 98.8; steam consumption per kilowatt-hour, 21.38 pounds.

Corrected for quality of initial steam pressure and vacuum the steam consumption figured as follows; at half load, 23.495 pounds; at full load, 20.957 pounds, and at 25 per cent overload, 20.674 pounds per kilowatt-hour.

Gas Turbine—*Power, Dec.* The solution of the gas turbine problem is occupying the attention and time of scientists and inventors the world over, but as yet the successful gas turbine is a thing of the future. The problem presents two general methods of treatment; First, the dry gas turbine; second, the turbine in which the products of controlled combustion are mixed with steam. Under each method two cycles of working fluid are possible, *viz.*, the standard Otto, or explosive cycle, and the Joule or constant pressure cycle.

It is conceded that the gas turbine offers peculiar advantages which are obtained in no other type of heat motor. Theoretically the gas turbine offers just as
good a thermodynamic efficiency as a piston en
constructive difficulties have prevented its
realization. The principal difficulties are thre
ber, *viz:*

1. The apparent necessity of working with
initial temperatures that no known construct
terial could long withstand their action.

2. The high rotative speed demanded in
realize good efficiency, thus creating stresse
yond the limit of the ordinary materials.
culty is found in the steam turbine, althoug
gas turbine would demand a still greater
velocity.

3. The difficulty of compressing the el
combustion to the highest pressure of the tu
and burning them under this pressure.

The wet gas turbine it is believed, offers
of the first two difficulties, the last mentioned
being the only impediment to its successful r
As to the first difficulty, suppose that a suitabl
of water be injected into the hot products o
tion. The principles of thermodynamics inv
be that of the steam boiler and furnace, exce
the boiler the flame is only under atmospheri
and is not in actual contact with the water, w
turbine combustion chamber the flame exists
same pressure as the steam and transmits it
actual contact. The resultant product is, i
case, pure steam; in the other, a mixture of s
hydrogen and carbonic acid gas. In any cas
sult is an exchange of small heat mass at
perature for greater heat at low temperature.

The thereotical efficiency will be somewhat
but not in anything like the proportion in whic
perature decreases. Again, the specific grav
mixture is greater than that of the dry gases t
in which case in the conversion of the heat
the gases into the kinetic energy, the resultar
is considerably decreased, thus presenting
for the second difficulty.

Large Steam Turbine Generator—
Electrical Age, Nov. It is only a short tim
a number of 5,000-kilowatt, three-phase gener
installed in the power house of the Manhatta
terborough station, New York city. A ge
5,500 kilowatts direct connected to a steam t
recently been tested at the Bullock works of
Chalmers Co. at Cincinnati. This machine a
formance is interesting on account of the
novel features, also on account of its high
perfect regulation and low temperature. Alth
generator has a normal rating capacity of
watts at either 6,600 or 11,000 volts, it must
of standing 6,680 kilowatts continuously with
more than 40 degrees C., and 8,250 kilowatts
hours without rising more than 55 degrees C.
overload, this generator will therefore requir
mover developing 11,500 horsepower. The
this machine revolve at a speed of 750 revolu
minute, making a peripheral speed at the surfa
rotating field of almost 15,000 feet per minute.
such conditions of speed the centrifugal force
tremendous magnitude and the careful distribu
calculation of the stresses and strains in th
members of the rotating magnetic field becom
of the utmost importance. The bursting of a
steel weighing 75,000 pounds rotating at the
three miles per minute would produce very d
results, and the responsibility placed upon the

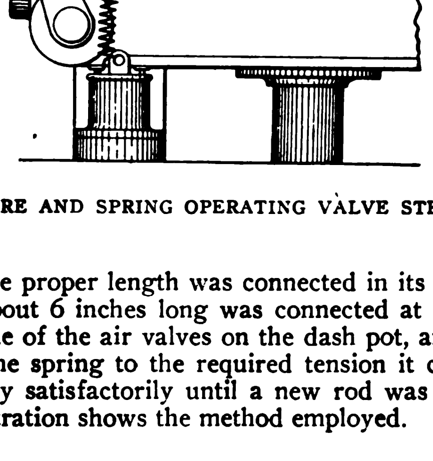
and builder is great. The highest stresses existing in any part of the rotating element do not exceed 15,000 pounds per square inch. At normal speed, therefore, the lowest safety factor is almost 5½, showing that these rotating fields might be run at twice their normal speed without flying asunder.

A problem of extreme difficulty confronted the designer in placing and securely fastening the field windings to the large steel blocks in such a manner that neither the proper conductors nor the insulation between them and the magnetic field can be injured by the centrifugal force to which they are exposed. This end has been obtained by flat copper strips which are made in such a manner as to give an increasing opening to each successive current. These strips are lodged in radial slots which are milled in the nickel steel disks and held in place by retaining wedges made from manganese bronze.

The electrical efficiency of this generator actually obtained from tests, is 94.4 per cent at quarter load, 97 per cent at ½ load, 97.9 per cent at ¾ load, 98.3 per cent at full load, 98.5 per cent at 1¼ load and 98.6 per cent at 1½ load. The regulation of the generator at full load at 100 per cent power factor is 7½ per cent and yet the generator has enough margin to give its full rated output on any power factor, however low.

Vibration in high speed revolving field generators, is such that frequently it becomes a source of serious difficulty. By carefully studying the problem and choosing such dimensions for the shaft that correspond to the natural vibration of the rotating element, and as much different as possible from the period of vibration produced by unbalancing at the normal rotative speed, it is possible to obtain safe and steady operation without fear of vibration.

Repairing a Corliss Valve Gear—*Merriam—The Engineer, Dec. 15th.* The dashpot rod on a Corliss engine broke and not having a new one in stock, the engine was kept running in the following manner: The rod was removed and a wire about 3-16-inch in diameter nd of the proper length was connected in its place. A ing about 6 inches long was connected at the lower l to one of the air valves on the dash pot, and by ad-ting the spring to the required tension it closed the ve very satisfactorily until a new rod was obtained. illustration shows the method employed.



WIRE AND SPRING OPERATING VALVE STEM.

Corliss Engine Repair—*Wakeman—Power, Dec.* The valve stem on a certain Corliss engine suddenly failed, as did also the cast iron sleeve carrying the stem, which broke off next to the shoulder, as indicated in Fig. 1. As the engine was so old that the patterns were no longer available, it was necessary to patch up the old sleeve in order that the engine might operate until a new one could be made. The valve stem was fitted with a T shaped head at the inner end, which fitted into a slot in the end of the valve, Fig. 2. A brass plate ½-inch thick, shown at *A*, Fig. 1, was securely fastened to the inside of the bonnet, thus forming the bottom of the stuffingbox on one side and a bearing for the head *B* on the other. The entire bonnet and sleeve were removed and put on a drill press, which was found convenient to hold the broken parts in place. Pneumatic drills were used in this shop and the handle of a drill was removed, a twist drill put in the drill press spindle, thus forming a guide for the pneumatic drill, and by this means two holes were bored endwise in the sleeve, one each side of the valve stem as shown in Fig. 2.

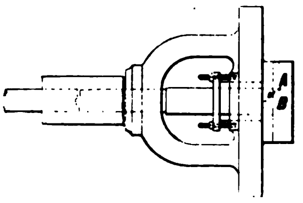


FIG. 1. THE CRACKED SLEEVE.

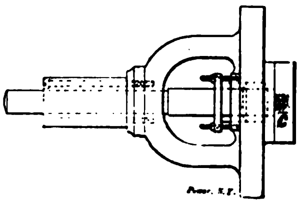


FIG. 2. SLEEVE AND VALVE STEM REPAIRED.

These holes were countersunk to receive the slotted capped screw heads. The holes were made smaller at the bottom and tapped to take the threaded screws. When the screws were firmly in place, the broken sleeve was held by them and used until the new one was completed.

A new valve stem was turned from material kept in stock for other purposes, the lathe belt being pulled by hand for this purpose. The inner end of this head was made smaller and threaded as shown at *C*, Fig. 2. The T shaped head was sawed from the old stem and bored and threaded to receive the end of the new stem, which being screwed into place, was securely pinned to prevent it from working loose.

These repairs were completed in 10 hours and made it possible to run the engine until a new pattern for the castings could be made.

Repairing an Engine Bed—*Colon—Power, Dec.* The manner in which the bed of an engine was repaired is as follows: The break was found to be nearly opposite the crankpin circle as shown in Fig. 1. Three pieces of wrought iron were obtained, two for the top side and one for the bottom, measuring respectively

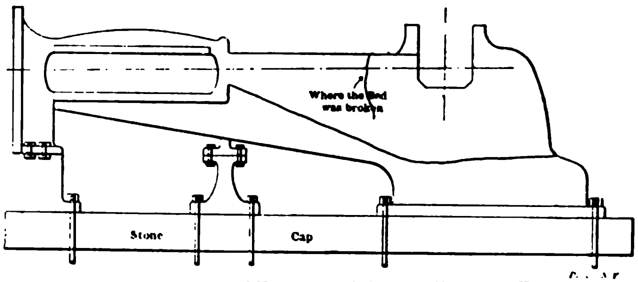


FIG. 1. CRACK IN THE ENGINE FRAME.

14 x 6 x 1½ inches, 14 x 6½ x 1½ inches and 14 x 12 x ⅞ inches. Two are shown at *D*, Fig. 2. Six holes were drilled in each one of the top plates, three in each end, and 12 holes in the bottom piece, corresponding holes being bored in the bed. As the crack opened about 1-16-inch when the crank passed the center and was opened 1-32-inch when the engine was shut down, the holes in the plate were drilled 1-64-inch nearer the center than the holes in the bed, so that when the tapered bolts were driven in, the bed would be brought to its original position.

One end of the top plate was first bolted in position, and a jack rigged up consisting of two pieces of hardwood timber braced, in this case, against a granite wall 9 feet distant, and in this manner the bed plates were forced together. When the other bolts were driven in place, the bed was as tight as when new.

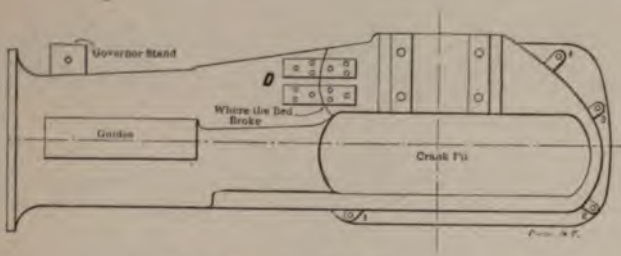


FIG. 2. THE CRACK AS REPAIRED.

By means of a 24-inch open wrench, the bottom plate was put in place as shown in Fig. 2. After some necessary readjustment the engine was started up and has given no trouble since.

Accident to a Cross Compound Engine—*Reagan—Street Railway Review, Nov.* In this accident the bell crank of a Bass Corliss release gear had gripped the sleeve outside of the stem, the cam ring carrying the cutoff. The stem also had gripped the bonnet. This is shown in Fig. 1.

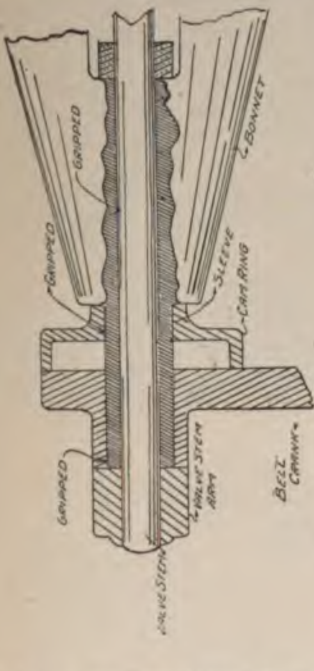


FIG. 1. WHERE VALVE STEM WAS GRIPPED.

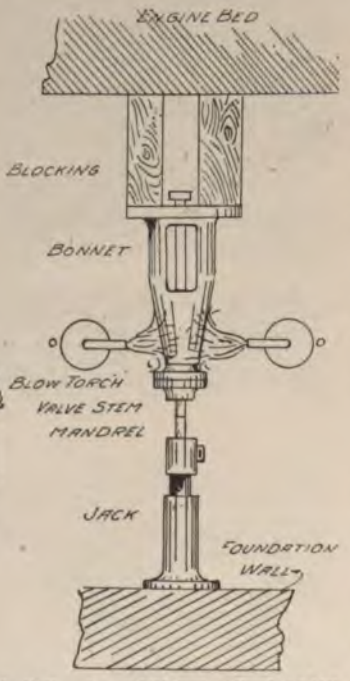


FIG. 2. HOW THE VALVE STEM WAS REMOVED.

When the bonnet had been removed and properly blocked, the efforts of two men and a 60-ton hydraulic jack were futile towards removing the stem. Finally two large blow torches were procured and the flame of each directed on the bonnet, as shown in Fig. 2. In due time a slight movement was perceptible and continued until the stem was driven out of the sleeve taking about eight hours to do so. It required care and alignment in order not to upset the end of the stem, and spring it out of line.

Air Resistance of Flywheels—*Electrical Age, Nov.* An interesting investigation was carried out recently at a German electrical power station, to find out how much power was being lost through flywheel air resistance.

Two tandem compound 450-horsepower engines, direct connected to generators and running at 95 revolutions per minute, the flywheels having arms with channel sections, which are known to offer great resistance to the air were used. To find what the loss of energy had been, one of the dynamos was made to serve as a motor for the engine without load. The motor consumption was found to be 13,000 watts without the flywheel covering, and 9,900 watts with the covering in place, showing a saving of 3,400 watts or about 5¾-horsepower. The money equivalent of this loss for a year was far in excess of the cost of covering the flywheel.

Are Any Flywheels Safe?—*Boehm—Power. Dec.* A recent flywheel wreck suggests the question whether there are any safe flywheels. Mr. Boehm then proceeds to give an account of several flywheel accidents which were caused by an accident to the engine, in each case exploding a second flywheel, to emphasize the fact that all flywheels, however sound, and however strong, are entirely at the mercy of the engine upon which they are fitted.

There are no safe flywheels. No one can expect mechanism, particularly mechanism of a modern steam engine to operate day in and day out, without sooner or later becoming deranged or having some accident happen to it. And when an accident happens to the engine a flywheel wreck, with all its disastrous consequences is almost certain to follow.

No flywheel is safe, for the simple reason that they are all attached to engines the mechanism of which is likely at any momement to get out of order and so accelerate the speed as to burst the wheels. It is for this reason also that flywheel wrecks occur more frequently than boiler explosions.

Future of the Gas Engine—*Electrical Age, Nov.* The gas engine should be a very good machine from a thermo-dynamic point of view but the difficulty of building large engines is an obstacle, which is yet to be overcome. Notwithstanding this fact, the gas engine seems likely to oust the steam engine for large power plants in the next few years.

The chances are that producer gases will be available at very low prices, and with large, well-made and efficient engines, rapid advancement will doubtless be made.

New Principle for Heat Engines—*Electrical Review, Dec. 16.* M. Cantor has suggested a new principle eat engines. An oxidizing medium is introduced he cylinder in the form of a solid and maintained incandescent temperature. A spray of fuel is ed against it, which will burn and the gas expand usual way, the reduced oxide being reoxidized jet of air. By this means the greatest possible of expansion will be obtained and the efficiency cycle will be increased.

BOILERS.

iler Power—*Hubbard—American Electrician,* Boiler power is computed from the steam con- ion of the engine used and varies with the size, , pressure and point of cutoff. The following gives about the average steam consumption per ted horsepower-hour of engines of medium size.

TABLE 1.

ype of engine.	Pounds of steam indicated horsepower per hour. Non-conds'g.	Conds'g.
e high speed	30—34	22—26
e Corliss	26—30	20—24
ound high speed	24—28	18—22
ound Corliss	22—26	16—20
exp. high speed	22—26	16—20
exp. Corliss	20—24	14—18

e higher figures may be used for engines from 75 o horsepower and the lower for engines of 200 to iorsepower. For engines smaller than 75-horse- r the figures should be slightly increased.

iowing the feedwater temperature and the probable ure to be carried, the factor of evaporation can ly be obtained from tables in any engineer's hand- Having previously determined from Table 1 the)er of pounds of steam required for the type of ie to be used, this quantity multiplied by the factor aporation and divided by 34.5 will give the boiler power required.

r example: What is the boiler horsepower re- d to supply steam at 100 pounds pressure from vater at 60 degrees temperature for a compound ensing Corliss engine of 200 indicated horsepower? ig the higher water rate from Table 1 for this type, ave 200 × 20 = 4,000 pounds of steam required our. Reference to a table of factors of evaporation s the factor for the condition given to be 1.19. efore, 4,000 × 1.19 = 4,760, which is the equiva- vaporation from and at 212 degrees, and 4,760 ÷ = 138, the boiler horsepower required.

steam is to be used for running feed pumps, etc., orsepower must be correspondingly increased. But pumps are very inefficient and only deliver about er cent of indicated power, when running under ary conditions, the steam consumption varies from iunds to 120 pounds.

the pump is feeding a boiler, the pressure should be ed to feet head, by dividing it by .4. The weight iter in pounds per minute, multiplied by the height et to which it is raised and divided by 33,000 give the delivered work of the pump in horsepower. or example, if a boiler feed pump is delivered 200 ds of water per minute against a pressure of 150 ds per square inch, the water being taken from a voir 5 feet below the pump, the boiler horsepower be ascertained as follows, assuming the pump to 20 pounds of steam per delivered horsepower-hour, ÷ .4 = 375 feet head, 375 + 5 = 380 feet total head, and 200 × 380 ÷ 33,000 = 2.3 delivered horsepower, from which the steam required will be 2.3 × 120 = 276 pounds per hour. If the temperature of the feedwater is 60 degrees and the boiler pressure 150 pounds, the factor of evaporation will be 1.2, and 276 × 1.2 = 331 pounds, the equivalent evaporation from and at 212 degrees. Therefore, 331 ÷ 34.5 = 9.6, the boiler horsepower required.

In the above example it has been assumed that the horizontal runs in the suction and discharge pipes are short, and no account has been taken of friction."

The power for electric lighting can be determined by assuming that one horsepower of electrical energy will supply a given number of lamps as indicated in table 2.

TABLE 2.

No. of lamps supplied by 1 h.p.	Type and power of lamp.
12	16-c.p. incandescent lamps.
6	32-c.p. incandescent lamps.
2.5	1200-c.p. arc lamps.
1.7	2000-c.p. arc lamps.

As the efficiency of a first-class generating set may be taken at 75 per cent, it will be necessary to divide the electrical horsepower by .75 in order to obtain the indicated horsepower of the engine from which the boiler horsepower can be determined by methods already explained.

When the exhaust steam is used for heating about 80 per cent of total steam may be considered available. If this amount is less than that required, additional boiler power must be added.

In plants of considerable size, it is a wise plan to have power in reserve in case of shut downs from any cause whatever.

FUEL.

Relative Cost of Power—*Power, Dec.* Considering the cost of fuel only, the relative cost per brake horsepower developed by gasoline, gas and steam engines is as follows: Gasoline engine, 78.00; illuminating gas with modern gas engine, 46.80; steam engine, 37.44; semi-water gas from anthracite, 7.80; semi-water gas from gas coke, 5.74; water and producer gas from bituminous coal 5.00.

These figures are based upon the assumption that a year consists of 312 days of 10 hours each; one-eighth of a gallon of gasoline is required per brake horsepower hour at 20 cents a gallon; an average of 15 cubic feet of illuminating gas is required per brake horsepower hour with automatic high pressure steam engines of small power with coal at $4.00 per ton; semi-water gas from anthracite will deliver a brake horsepower hour from one pound of coal in the generator, with coal at $5.00 per ton; semi-water gas from gas coke will develop a brake horsepower hour on .92 pounds of coke at $4.00 per ton; water gas with plants of 500-horsepower and over, will produce a brake horsepower hour on .80 pounds of bituminous coal at $4.00 per ton.

Low Grade Fuels—*Goodrich—Engineering Magazine, Dec.* This study is based upon conditions existing in London, but the author's deductions may readily be applied to the situation at other places.

The utilization of low-grade fuels materially reduces the cost of steam generation and accordingly the cost of production, notwithstanding the fact that this is exactly contrary to the idea held for many years by reputable engineers. The economy obtained depends upon the following specific conditions:

1. The cost of good steam coal and its calorific value.
2. The comparative cost of small and low-grade fuels and their calorific values.
3. Whether the cheaper fuels are burned under such conditions as will ensure that the full calorific value of the fuel will be realized.

For purposes of argument, a very good grade of steam coal having an average calorific value of 14,500 British thermal units and costing about $5 per ton is compared with a bituminous slack coal, costing about $3 per ton and having a calorific value of 12,500 British thermal units.

Without entering into any calculation it must be evident to anyone, that the extra weight of bituminous slack which must be burned in order to evaporate the same weight of water, as is possible with the steam coal, is very materially less than the comparative cost of the two fuels.

Generally speaking, the percentage of incombustible in low-grade fuels is not high, varying from 9 to 20 per cent, and consequently is of no importance comparatively.

It is a common delusion that a small fuel must necessarily be of a low calorific value and accordingly of doubtful economic value, if it can be burned at all. As a matter of fact many small fuels are of excellent calorific value and, when burned with suitable appliances show a phenomenal saving.

REFRIGERATING.

Repairing a Cracked Compressor Cylinder—H. R. M. *Power, Dec.* The loosening of one of the discharge valve seat bushings, which worked through and dropped into the cylinder before it was detected, resulted in the cracking of a compressor cylinder of 16 inches in diameter. It was repaired in the following manner. A radial slot 1½-inch wide was cut to the full depth of the flange, about 4 inches on each side t crack in the cylinder, as shown in Fig. 1, where worst leak occurred, and carefully finished on th adjacent to the crack.

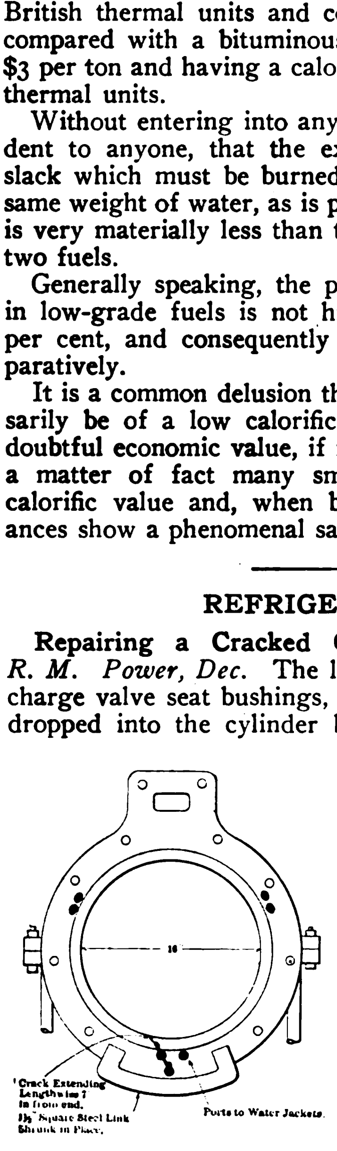

16
Crack Extending Lengthwise 7 in from end.
1½" Square Steel Link Shrunk in Place.
Ports to Water Jackets.

FIG. 1. SHOWING CRACK.

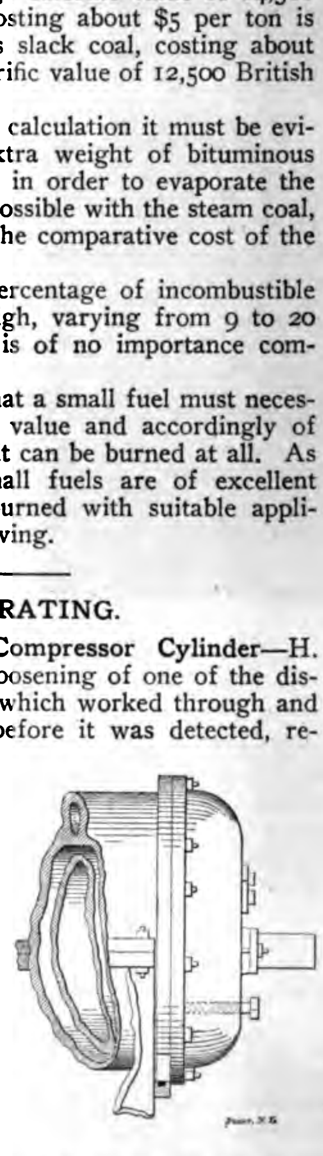


FIG. 2. CRACK REPAIRED.

A link was then made of 1½-inch square st curved to the shape of the flange, with the ends outward to correspond with the slots, and c finished on the inner sides, so that it lacked the slots by about 1-64-inch more than the width of the crack, as nearly as could be determined.

A ⅜-inch hole was drilled, tapped and plugged at the end of the crack to prevent it from "growing."

Next the link was heated to a fair red heat so it would enter the slot easily, after which a cement was rubbed in to make a rust joint in the crack. When the cement had cooled the crack could hardly be detected and was perfectly tight.

The cylinder head, which was cracked at the same time, was remedied by drilling and tapping a ⅞-inch hole through the water jacket and forcing the metal back nearly to its original position, by screwing a bolt with a long thread through the jacket and against the head proper, and then applying a liberal amount of the same cement. This is shown in Fig. 2.

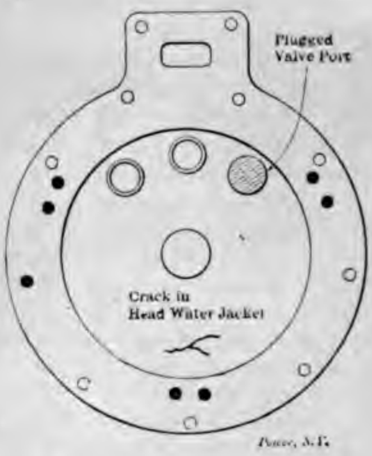


FIG. 3. PLUGGED VALVE PORT.

The loss of the valve seat bushing, which was demolished in the cylinder, necessitated the tapping out of the hole with a 2½-inch pipe tap and screwing in a plug which was trimmed off flush with the inside of the head, which left two valves to discharge the air from that end. The plugged valve port is shown in Fig. 3.

The following extracts are from papers read before the Refrigeration Engineers' convention, which met in New York, December 4 and 5 for their first annual convention.

President W. Everett Parson read a paper on "Pipe Line Refrigeration" for the distribution of refrigeration by pipe lines under the streets and public places for supplying consumers, treating both upon the brine and direct expansion system.

Brine lines now in operation have the usual two pipe flow and return system with refrigeration coils connected in multiple. The brine is cooled in the brine cooler of the shell and coil type. The power required for distributing the brine raises directly with the head and the range of the brine. Assuming a range of 5 degr between the outgoing incoming brine and a
eet, we have
ower per
as measured
efficiency of the a
o o -horsepower

ng material, soaked in some moisture resisting ound. Hair felt soaked with a mixture of rosin araffine oil is successfully used in one case and lated cork soaked in pitch in another case. The proofing compound is necessary to prevent the ure of the ground from being absorbed by the in- on material and thereby destroying its insulating .

ctically all of the ammonia lines have been laid what has been termed the three pipe system, con- g of a liquid line under pressure, by main and h to the expansion valves at the refrigerator; a n or vapor line carrying back the gas; and a third alled the vacuum line.

e expansion coils in the refrigators are connected ltiple between the liquid and the vapor line. The m line is connected to each expansion coil on the ide of the stop valves on the liquid and vapor lines. irs at any refrigerator can thus be made without rbing the balance of the system. The vacuum can ed as a bridge line to carry liquid over a block e there may be a leak on the liquid line. Its use is imperative in extensions of existing lines to carry ammonia to test out new lines without disturbing peration of old ones.

e ammonia lines are laid in a conduit of vitrified or lazed split sewer pipe, the lower half of the con- being first laid in concrete, then the ammonia lines un and tested, then the top half of the conduit is n and cemented.

e expansion line has enough piping to superheat as to nearly the temperature of the box and pre- frosting out into the return main. In small refrig- n, however, it is very difficult to prevent frosting nd whenever possible such boxes are connected in to other boxes. Where a number of small boxes rouped, a brine cooler is installed, fed from the lines the brine circulation being used locally.

e temperature of the mains in the conduit seldom above 75 degrees in the summer. This corre- ls to an ammonia pressure of 126.5 pounds. With rresponding pressure of 150 pounds, the dis- tion of a given tonnage, or its correspond- amount of liquid could be calculated on a of 23.5 pounds, but as it often happens that and there liquid service lines run through warmer of temperature, it is not safe to rely upon the tem- ure of the mains. In practice, therefore, a drop pounds has been considered about the outside al- ice for friction head.

tracts from Edgar Penkey's paper "Plate *versus* System" are as follows: The "plate" system de- its name from the practice of freezing water st the external face of a metallic plate maintained eans of mechanical refrigeration at a temperature 32 degrees F. The can system consists of freez- vater in open top metal cans, which are exposed to ezing temperature, either by a partial immersion in chanically cooled non-freezing bath, in a properly d room, or in the open air, when below 32 de- F.

e problem in can systems is to disassociate the dirt water before the molds are filled, but how to pro- water on the large scale required in the modern can ctory is a vexatious question.

plate ice has its growth in thickness from one side the exterior face being always in contact with ing water, the formation of ice proceeding from the ing plate outward, certain undesirable qualities of ater held in solution or mechanically suspended or other than chemically fixed are separated and rejected by slow freezing water and pass into and are taken up by the residual or unfrozen water, which at the termination of the freezing period is drained off, the tanks then being refilled with fresh water.

In water heavily charged with carbonates, etc., as, for instance, lime, clear crystal ice can be obtained by a slower rate of freezing, thus giving time for elimination providing a larger percentage of residual water to take up the off scour without becoming over saturated, or a more frequent change of water during the stated run.

The principal elements in the selection of plates and can systems may be contrasted as follows: Both systems under intelligent management will produce ice of good quality, but the can system depends upon a complicated arrangement of distilling and filtering apparatus, which permits rapid deterioration in quality if not carefully watched and kept in an effective working condition.

Plate ice possesses the desirable quality of keeping in storage equally as well as natural ice, without resort to mechanical refrigeration to prevent rotting and crumbling. Can ice on the contrary does not lend itself favorably to storage and to preserve a good quality of ice the store rooms must be maintained by mechanical refrigeration at a point equally as low as the freezing tank where frozen.

Water, gas, electricity or any cheap motor power can be used for producing plate ice, but when distilled water is required the can system must require steam, therefore, the economy in the distilling steam boiler is the only feature of fuel cost.

Where water is highly impregnated with lime, etc., or gaseous products, capable of vaporization and condensation, the plate system can be used if operated at a slow rate of freezing, as, for instance, sea water can be frozen on the plate system while very opaque and difficult to handle on the can system.

Louis Block read a paper, "The Evaporator for Use in Distilled Water Ice Plants," from which the following extracts are taken: In all ice making plants with evaporators now in operation the Lilly evaporator has been used. It consists of a cast iron shell and is provided with cast iron tubes. Near one end is the tube head, which divides the evaporator into two parts, a steam space and a vapor space. Under the evaporator a centrifugal pump is placed which serves to circulate the water through the tube.

The exhaust steam from the low pressure cylinder usually under a vacuum of 18 inches, at a temperature of 169 degrees F. enters the steam space of the evaporator and passes to the copper tubes. The water which is pushed through the tubes in the vapor space of the apparatus evaporates owing to the lower vacuum of 25 or 26 inches which, by means of the condenser and air pipe is maintained in this space. The temperature or vapor under a vacuum of 26 inches, is 126 degrees F., and the difference between 126 degrees and 166 degrees is quite sufficient to produce boiling and consequently evaporation. The steam which enters the copper tubes is condensed, drops to the bottom of the steam space and from there is periodically discharged into the steam condenser.

The vapor is, of course, pure, clean and free from any odor owing to the fact that it is distilled at a low temperature; the steam, however, having done its work in both the high and low pressure cylinders of the engine, contains impurities, *viz.*, oil, oxide of iron and free ammonia. In order to free it from oil and oxide of iron it must be washed or passed through a coke scrubber in the usual way, except in this case, the oil extractor or coke scrubber must be operated under the same vacuum, which is maintained in the steam space of the evaporator. After leaving the evaporator it enters the tube of the steam condenser from which it flows by gravity to the vacuum reboiler. In the reboiler of the ordinary ice plant the condensed water reaches it at a temperature of from 125 to 130 degrees, which must be heated to 212 degrees before it boils and the resulting vapor passes through the vapor pipe out of the roof and is lost.

There is only one place where loss of heat takes place, which can be prevented and that is at the blowoff cock of the evaporator, because from time to time some of the water contained in the vapor space must be blown out for the purpose of preventing evaporation to dryness and excessive accumulation of scale of the evaporation tubes.

W. Everett Parsons read a paper entitled "Indicating the Ammonia Compressor," extracts of which are as follows. It requires intelligent forethought, much preparation and eternal vilgilance to keep a refrigeration or ice making plant up to its maximum capacity and highest efficiency during its continuous run for a period of four of five months. There are no better means of ascertaining whether the various parts of the compressor are performing the various functions properly, than the use of the indicator, such as is used for steam engines and yet, we find a large number of compressors with no connections or rigging provided for attaching an indicator. At a large number of plants we find no indicators. There are some places, however, where indicators, connections and rigging are all provided, and the operating engineer never uses them. But, most remarkable of all, the majority of chief engineers who operate refrigerating machines, not only do not indicate their own compressors, but resent the suggestion that someone else do it for them.

Many interesting things may be learned from indicating the compressor. In one instance, an engineer was in favor of the wet compressor system and made no use of the water jacketing, maintaining that his compressor was all right. The indicator showed that the discharge valve at the head end required an excess of pressure upon it, and that it did not open wide enough, and did not close properly. It also demonstrated that he was admitting too much liquid ammonia to his compressor. The loss due to the clearance was about 17 per cent, but later was easily reduced to 10 per cent.

It was also discovered that a high pressure ammonia gage was indicating about 25 per cent higher than actual pressure. In consequence of the apparently too high condensing pressure the engineer was spending a large sum for additional condensers, in order to reduce the pressure.

In another instance an engineer considered it proper to circulate as much liquid ammonia as possible, although he admitted that he did not freeze back as hard as his predecessor had. An indicator card showed the engineer (after freezing back had been reduced until the discharge was hot) that the refrigeration work done was not always in direct proportion to the intensity of the freezing back. The diagram also showed that one of the valves was leaking badly.

An engineer in order to understand the value of compressor diagrams must be able to properly read and understand them. Diagram from ammonia compressors are much more difficult to read than those from the steam engine.

MISCELLANEOUS.

Rope Pipe Wrench—*Johnson*—*American Mac ist, Dec.* Following is an interesting kink in wh a rope is used for rotating a pulley when grindin upon a shaft. In Fig. 1 is shown a "one man" arrar

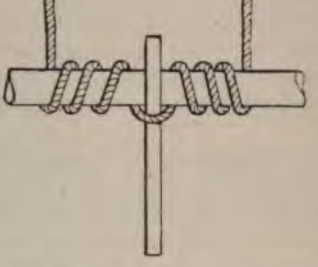


FIG. 1. ONE-MAN ARRANGE-MENT.

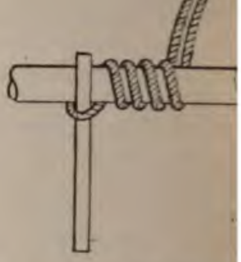


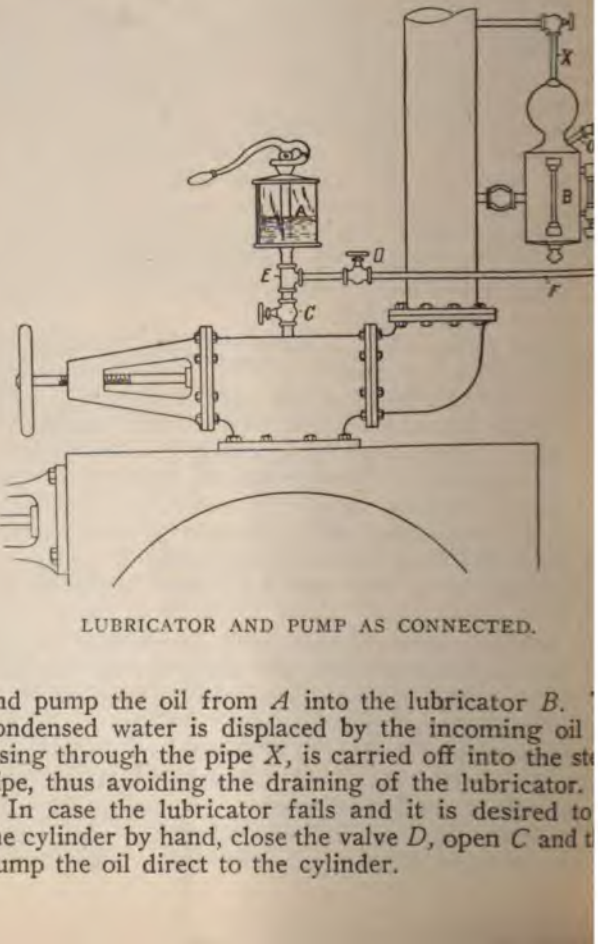
FIG. 2. TWO-MAN ARRA MENT.

ment in which the ends of the rope are held by hand and the toggle is pulled with the other.

The arrangement shown in Fig. 2, is for heavy w and requires two men, one holding the end of the r the other handling the toggle.

Lubricator Kink—*Boyer*—*Popular Mecha Dec.* The illustration shows a lubricator kink: tween the pump cup *A* and the throttle or steam c insert the valve *C* and the tee *E*. In the ½-inch F insert the valve *D*, the pipe *F* enters the lubric at the filling hole at *O*.

In order to fill the lubricator close the valve *C*, ope



LUBRICATOR AND PUMP AS CONNECTED.

and pump the oil from *A* into the lubricator *B*. condensed water is displaced by the incoming oil rising through the pipe *X*, is carried off into the st pipe, thus avoiding the draining of the lubricator.

In case the lubricator fails and it is desired to the cylinder by hand, close the valve *D*, open *C* and t pump the oil direct to the cylinder.

Lubrication—*Street Railway Review, Nov.* An especially interesting discussion took place at the Philadelphia convention in regard to the lubrication of street railway motors and car journals.

The use of grease is being abandoned by most roads as it leads to the consumption of a great deal of additional power. The cost of oil lubrication varies greatly with the conditions of operation and type of feed apparatus, but even at its highest price, it is cheapest in the long run on account of the great saving in the cost of repairs, as well as in the saving of power.

The Gas Producer's Worst Enemy—*Power—Dec.* No greater damage can be inflicted on the interest of an industry than is caused by the misrepresentation, intentional or otherwise, of the facilities employing it. The writer has heard of many cases and knows personally of a few in which over-enthusiastic efforts to advance the cause of the gas producer have resulted in serious mistakes being made in the installation of the plant, with the consequence that the equipment was thrown out and the gas engine and producer were accursed forever.

Two of the most common mistakes in producer installations appear to be the overrating of the producer and the provision of the simple suction pipe to supply a widely varying load. One is about as fatal as the other, and both seem to be due to mistaken efforts to impress the buyer with the extraordinary economy of the system.

Unfortunately there is no recognized basis for rating gas producers. Each manufacturer appears to follow his own notion on this point, and the various notions differ distractingly. Many producers are rated on the basis of burning 15 pounds per hour per square foot of grate surface, and some are put as high as 20 pounds; more conservative builders are content with 12½ pounds of coal per hour per square foot, while one, at least, figures on the very safe rate of 10 pounds.

The excessive gas necessary to get the output of an overrated producer is bound to honeycomb the fire and produce lean gas; this is what usually happens when the attempt is made to burn 18 to 22 pounds of coal per hour per square foot of grate.

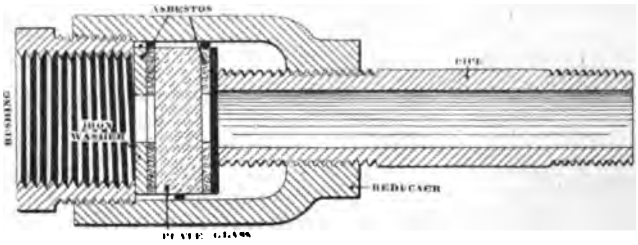
At 15 pounds satisfactory results are obtainable, we are assured, if the bed of the fuel is kept level and the ashes are kept down; while at 12 pounds no difficulty is found in getting the proper service without crowding the producer and without employing the highest grade of skilled labor.

It is not difficult to operate such a producer on fluctuating load when proper precautions are taken for obtaining continuous combustion and maintaining a small reserve supply of gas, but the hand to mouth character of operation which has been attempted in some instances is impossible.

Combustion Sight Hole for Gas Engine—*The Gas Engine, Nov.* A device for testing gas engines known as a combustion sight hole and adapted for use with make-and-break igniters, is shown in the illustration. Screw a pipe nipple of ½-inch size having a long thread at one end, into the cylinder head. On the other end of the nipple screw is a 1 x ½-inch reducer, into the outer end of which is screwed a 1 x ¾-inch bushing to be used as a stuffingbox nut in holding a piece of thick plate glass into position at the end of the ½-inch nipple.

Use asbestos gaskets to separate the glass from the nipple and the iron stuffingbox washer. The distance of the glass from the inner side of the cylinder head should be several inches, to prevent its becoming overheated and breaking and its diameter should be so small that it does not touch the inside of the reducer.

This apparatus enables one to view the interior of the gas engine while the engine is in motion. For safety do not put the eye too close to the glass, but stand several feet away.



SIGHT DEVICE.

Pressure Drop Through Poppet Valves—*Lucke—Paper before A. S. M. E., Dec. meeting.* This paper contains interesting data concerning the pressure drop through poppet valves. The drop for a given rate of flow is dependent upon the fluid density, velocity, form of opening, form of approach and exit, character of flow, whether steady or intermittent, inertia of the fluid and friction of the passages.

The pressure drop through a valve is necessary to secure any flow whatever and is detrimental on account of resistance offered to the piston, yet it can be reduced to a minimum by proper design.

The paper contains data concerning the drop through flat seat and conical valves at different rates of flow.

Slip of Discharge Valves—*Benjamin—The Engineer, Nov. 15.* Tests made during last winter at the Case School of Applied Science with a 4 x 6-inch power pump driven by a belt from a counter shaft gave the following results under conditions here given:

PER CENT SLIP AND AVERAGE LIFT OF DISCHARGE-VALVE.

Spring.	R. P. M.	Pressure.	Displ'm't.	Discharge.	Slip.	% Slip.	Av. Lift.
A	40	50	260	256.49	3.51	1.35	0.125
"	"	75	"	256.20	3.80	1.46	0.133
"	"	100	"	255.91	4.09	1.57	0.142
"	50	50	"	256.30	3.70	1.42	0.172
"	"	75	"	256.30	3.70	1.42	0.183
"	"	100	"	255.91	4.09	1.57	0.190
"	60	50	"	256.01	3.99	1.53	0.205
"	"	75	"	255.62	4.38	1.68	0.215
"	"	100	"	254.94	5.06	1.95	0.223
B	40	50	"	256.88	3.12	1.20	0.090
"	"	75	"	255.91	4.09	1.57	0.100
"	"	100	"	255.82	4.18	1.61	0.100
"	50	50	"	257.17	2.83	1.09	0.128
"	"	75	"	256.49	3.51	1.35	0.132
"	"	100	"	255.43	4.57	1.75	0.148
"	60	50	"	256.01	3.99	1.53	0.157
"	"	75	"	255.43	4.57	1.75	0.162
"	"	100	"	254.94	5.06	1.95	0.170
C	40	50	"	256.59	3.41	1.31	0.065
"	"	75	"	255.72	4.28	1.65	0.067
"	"	100	"	255.23	4.77	1.83	0.070
"	50	50	"	257.17	2.83	1.09	0.083
"	"	75	"	256.30	3.70	1.42	0.083
"	"	100	"	255.91	4.09	1.57	0.098
"	60	50	"	256.20	3.80	1.46	0.107
"	"	75	"	255.43	4.57	1.75	0.113
"	"	100	"	255.04	4.96	1.91	0.122

The pump was arranged so that variable speeds were obtained while the throttle valve and air chamber on the discharge pipe served to regulate the pressure.

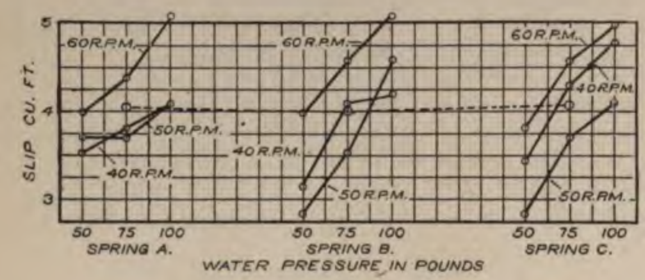
To determine the time and amount of lift of the discharge valves on one of the pump cylinders a Crosby indicator was connected with a valve. A yoke on the top of the valve supported a light steel rod which passed vertically through a carefully fitted brass bushing and was connected to the pencil movement of the indicator, the usual piston and spring being omitted. A light coil spring was placed inside the indicator to prevent the water pressure from forcing out the rod, and to always keep the latter in contact with the yoke of the valve.

Each valve spring, designated as *A*, *B* and *C*, consisted of four coils of hardened brass wire, forming a helix 1.75 inches in diameter, and showed when calibrated in a testing machine, a scale per inch of compression as follows: $A = 1.3$ pounds; $B = 2.4$ pounds; $C = 6.66$ pounds.

Each test was run for 2,000 revolutions of the pump, or 6,000 strokes. The pump was run at three speeds, 40, 50 and 60 revolutions a minute, the rated speed of the machine being 50 revolutions a minute. The pressures on the discharge lines were 50, 75 and 100 pounds per square inch. Four cards were taken, one for each 500 revolutions.

The speed of the pump had considerable influence on the movement of the valves, the lift increasing with the speed. The results of these tests are summarized in the table and in the chart, a study of which brings out the following salient points.

Of the three variable factors, valve lift, speed and water pressure, the last named has the most to do with the slip, as shown by the upward trend of the lines in the chart, the slip increasing with the water pressure.



DIAGRAMS SHOWING THE SLIP WITH A VARIATION OF SPEED AND PRESSURE.

Generally the slip is less for the medium speed of 50 revolutions a minute and is greater when the speed increases or decreases from this point. The dotted line in the chart shows that little effect on the discharge is produced by the lift of the valve. The dotted line which is practically horizontal denotes the center of gravity of the three groups of points.

It is remarkable that an increase of from 50 to 100 per cent in the lift of a valve should not increase the slip, but all of the experiments point to this condition and show that it is practically the pressure in the discharge pipe which determines the difference between the calculated and the actual discharge of the pump.

Selection of Direct Current Motors—*Clark Cassier's Magazine, Dec.* The prospective buyer of a direct current motor should first carefully consider the character of the work to be done, conditions surrounding location, type and capacity required.

The selection should be made with regard to obtaining the most accessible machine with respect to commutators, brushes, holders, wiring and connections. If these features are procured, unnecessary delays, in case of a shut down, will obviously be avoided.

The shape of the motor should be such as to prevent all parts from external mechanical injury, and flexibility in regard to location is also desirable. Standard makes should always be used in preference to special machines on account of the interchangeability of parts.

Ornamentation is undesirable and the machine should be provided with an eye bolt to facilitate lifting and moving. Visual inspection of the oil rings in the bearings, while the machine is in operation, is possible in some machines and is a good feature.

The commutator segments should be of sufficient depth to allow for wear and turning down and the brushes should be carefully selected with an idea of obtaining perfect commutation without cutting. Flexible connections from the brushes are used where the current exceeds 15 amperes.

Probably there is no one machine which possesses all the advantages on the market, but there should be no difficulty in covering the general requirements.

Standard Proportions for Machine Screws. A committee appointed by the American Society of Mechanical Engineers met several representatives of screw manufacturers and agreed upon certain diameters, pitches and limits for standard machine screws as announced in their report presented at the December meeting.

The Sellers or U. S. standard thread was agreed upon and all diameters are to be expressed in decimals of an inch.

To secure interchangeability of machine screws and taps, three standard gages are necessary: A basic, one for screws and one for taps.

The basic standard represents exactly in every detail the U. S. form of thread; the diameter at the top and bottom of thread, the pitch and the included angle of 60 degrees being the same. The flats at top and bottom of thread are also each equal to ⅛ of the pitch.

The standard for screws should be like the basic standard in every detail with the exception of the diameter at the bottom of the thread, being due to the decreased width of flat, which is only equal to 1-16 pitch at the bottom of the thread in screws.

The gages for taps are to represent in every detail the size of a threaded tap before being fluted. This would represent the basic standard in every respect with the exception of an increased external diameter due to a flat of 1-16 pitch at the top of the thread.

This decrease in the internal diameter of screws and increase in the external diameter of taps is for clearance.

As it is obvious that the sizes of taps and screws cannot be made commercially to correspond with the standard, formulae for the limits of variation are included in the report.

The report also contains standard proportions for all machine screws.

Flue Gas Analysis of a Water Tube Boiler—*Engineering Record, Dec. 23.* The following is the result of a series of tests which were made to show the character of the gas from a hand fired water tube boiler with a plain furnace and ordinary setting under certain conditions of running, the test being made with the

Orsat apparatus. The boiler was one having ordinary vertical flame plates, and three vertical passes for the gases, being 125-horsepower in size.

The sample pipe was introduced between the third and fourth rows of tubes. Connected from the tubes in the rear through a hole driven for that purpose was a pipe ¾-inch in size and 4 feet in length perforated with 72, 1-16-inch holes, arranged in three rows, 24 holes in each row.

The pipe was laid on the tubes beginning at a distance 12 inches from the inside face of the outer wall, the connection with the gas apparatus being made through a ¼-inch pipe.

The samples of gas were drawn for periods of one minute and were taken twice during a period, while one firing was being turned out, the first sample being taken two minutes after firing and the second some 20 minutes. The firing occurred at intervals of about 30 minutes.

The interest in this analysis lies in the effect produced by the different conditions of the fire. On the first test, which was made one minute after firing 20 shovels of coal, the carbon dioxide was 12.4 per cent, the oxygen 4.4 per cent and the carbonic oxide 1.1 per cent. After the expiration of 28 minutes during which time the fire had been barred up, the second test was made which showed that the carbon dioxide had fallen to 10.7 per cent, the oxygen had increased to 9.3 per cent and the carbonic oxide had fallen off to 1-10 of one per cent, thus showing an increase in the amount of surplus air and a marked improvement in the combustion due to the reduced quantity of volatile gas as the fire burned down.

The third test was made two minutes after firing 32 shovels of coal and showed for carbon dioxide 14 per cent, oxygen 2.1 per cent and carbon oxide 2 per cent. The new coal added on this fire was an excessive quantity, and this was revealed at once by the increased amount of carbon dioxide and a reduced percentage of oxygen in the gas.

The next test was made 24 minutes later, the sample being drawn one minute after the fire was leveled off. This test showed 16.9 per cent carbon dioxide, 1.2 per cent of oxygen and 1.3 per cent carbonic oxide.

One the fifth test a sample was drawn two minutes after firing 20 shovels of coal, which showed an almost duplication of the previous test, the result being carbon dioxide 13.7 per cent, oxygen 2.2 per cent, carbonic oxide 2.5 per cent. At the expiration of 24 minutes from this time the sixth drawing was made, which occurred five minutes after barring up the bed of coal without leveling it off. The result of the analysis showed very different from the corresponding time on the previous test, the carbonic oxide disappearing altogether, the carbon dioxide being 13 per cent and the oxygen 6.4 per cent. This shows that the open condition of the coal bed allowed a large supply of air to pass through which increased the oxygen in the gas.

The seventh test was made two minutes after firing 20 shovels of coal, and showed carbon dioxide 14 per cent, oxygen 2.7 per cent and carbonic oxide 1.7 per cent. At the expiration of 15 minutes the eighth sample was drawn, this being done six minutes after the fire was opened with a slice bar, and not leveled off. The qualities then changed, the carbonic oxide disappearing altogether, the carbonic dioxide falling to 11.6 per cent and the oxygen rising to 8 per cent.

The effect of a thick bed of coal reduced the quantity of free oxygen in the gases, which, however, was accompanied by considerable quantity of unconsumed carbon, therefore resulting in no benefit.

REPRESENTATIVE MEN FROM THE ENGINE ROOM, 29th—ROBERT ANDERSON.

Robert Anderson, the subject of this sketch, was born in Sonderburg, Schleswig-Holstein, July 18, 1867. He there received a common school education. His parents had planned a theological career for him, but on account of financial reverses this was abandoned.

Determining to strike out for himself, he came to this country in April, 1883. He obtained his first engineering experience in a sawmill in Manistee, Michigan, working as a fireman, and in the repair shop of the mill during the winter months.

Showing an interest in his work, he was eventually promoted to assistant engineer. Feeling the need of more extended experience, he went to Chicago in 1891 and for a time was night enginer at the Union passenger station. His next position was in the E. P. Allis Co.'s shops at Milwaukee, Wis., as machinist and electrician.

ROBERT ANDERSON.

Next we find him chief engineer of the Davidson theatre, Milwaukee, and later chief engineer of the Goldsmith building, a large business block.

On the completion of the new city hall, he was, after passing a civil service examination, appointed superintendent of that building.

Taking over this up-to-date power plant from the contractors, he, with perseverance and good judgment, brought it into a successful running condition.

At the end of four and one half years he resigned to take charge of the new and enlarged power plant of the Milwaukee Harvester Co., now part of the International Harvester Co. As in his former positions, so here, he has been the right man in the right place.

He has recently resigned this position to go with the J. I. Case Threshing Machine Co., of Racine, where he will have charge of the rebuilding of their power plant.

Mr. Anderson has held several offices in the N. A. S. E. and stands high in the esteem of all who know him.

XCHANGE DEPARTME

Faulty Flywheels.

A Corliss engine had been properly installed by experts from the shops of the builder in a certain factory. Owing to a delay in the delivery of the driving belt it was put on by local workmen, and a botch was the result. They failed to get the proper alignment with the driven line shaft as the belt ran over on one side, they proceeded to adopt strenuous measures to keep the heavy belt in the middle of the wheel. They made a roller out of iron, with a [illegible] flange on each end and arranged it as a guide for the belt, as shown at A, Fig. 1.

The roller was operated on a metal shaft supported by bearings fixed with bolts to the framework of the engine journals as shown. This roller heated frequently, due to its high speed and gave much trouble. It also wore off the edges of the belt and caused some of the laps to open.

Finally a man came along who undertook to fix things. He removed the roller, tightened the belt and fooled away with some strips of tin adjusted at various points of the shaft and engine bearings, for the purpose of leveling them, as he supposed, but the belt ran over the side of the wheel just the same.

Next, an engineer of wide experience took a hand at it, and instead of operating upon the belt and bearings, he made accurate measurements of the wheel itself, resulting in the discovery that through incorrect adjustment of the rim, the joints were uneven. The wheel had been shipped in four sections and in putting up these sections, evidently, they were not correctly joined. The condition that existed, greatly exaggerated, is presented at B, Fig. 2, in which the tilting of the rim at the joint can be seen. This variation was hardly perceptible in the running of the wheel. Still, the defect was of ample capacity to make the belt wabble and run to one side. The way in which the trouble was remedied involved considerable filing on one side of the joints, while the other sides were built up with thin bits of sheet metal. After about three hours of tinkering, the wheel was put into correct alignment. Then all the fixings for holding the belt in position were removed and the belt thereafter ran on the center of the rim, and gave no further trouble.

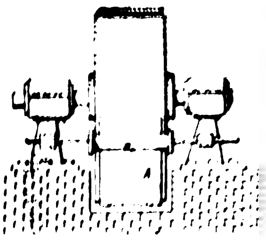


FIG. 1. ROLLER USED AS A BELT GUIDE.

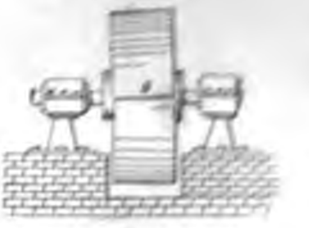


FIG. 2. FAULTY FLYWHEEL JOINT.

Another flywheel case that came to my notice recently was one utilized to carry the belt for running the shaft line. The belt had bothered a great deal by slipping on the smooth metal surface of the wl rim. Rosin, molasses, and belt composition had l rally led as was indicated by the spatterings the engine foundation. In ord

ping, one of the workmen finally put on a thi ing made from a part of a wide belt. This la put about the wheel, the ends laced, and the eled. The lag prevented the slipping, but new complications by wearing one side of t lagging ragged, as indicated at the arrow poin rivet heads protruded and wore long groov main belt.

The first remedy for this evil involved th removal of the lagging and cutting off the ri

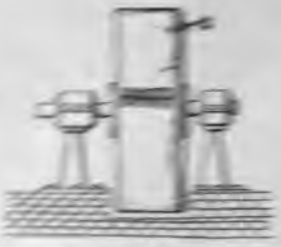


FIG. 3. WORN LAGGING.

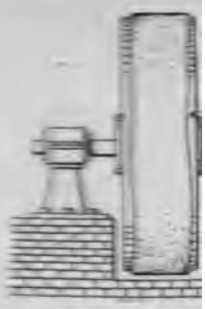


FIG. 4. BELT SH SULT OF TIGHT R

reason for the slipping of the belt was due t that some additional machinery had been crow the engine. To overcome this, the flywheel w as well as the driven wheel on the shaft, with w extending about 1½-inches over the edges of ei of both wheels. These lags were securely b This gave us an opportunity to put on a belt wider than the one that bothered so much, and ping ceased.

Fig. 4 is a drawing which resembles nearly the condition in which the leather belt operated on a flywheel. By standing opposite the rim, one c the belt see-saw from side to side, almost to th

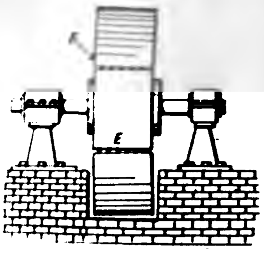


FIG. 5. ANOTHER FAULTY JOINT.

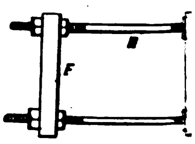


FIG. 6. JACK USED SECTION OF FLYW

of running off at times. The arrow D, indic variation. The slackness so essential to engi and so readily obtained when the conditions a was absent in this case, and the belt was dra taut. The laces were un ready to draw out. The but it worried the engine

Fig. 5 show use defect is enlar rd reality, th d t the

:rips of tin came into service. Every one of the s had to be opened. The file had to be applied liby for half a day, first at one point and then at anr on the points. Then by building up at low points as possible to get the joints square. Some of the holes were thrown out of line, and filing with a .d file was necessary to enlarge the hole to receive ɔolt. After the whole rim was joined up right, we .d that the bore of the wheel was inaccurate. Here a problem. The entire wheel had to be removed the hole turned out with a cutting tool. Although ı light shaving was taken off, it was enough to make bore exceed the diameter of the shaft, and a thin re of brass was made to occupy the space. Two or e days' work was required in getting this wheel t.

ig. 6 is one of the convenient jacks we rigged up to the rim sections with. The ends *F, F,* are hard d, with holes bored through for the bolts *G, G.* section of the wheel may be gripped in a firm bite djusting the jaws on either side and tightening up he nuts of the bolts. A Tramp Mechanic.

Steam Engines.

here is probably no part of an engine that requires e intelligent care relative to safety and economy ı the cylinder-and piston of a steam engine. Negin an examination of these two important parts of ngine often leads to waste and disaster. One of the t common causes for cylinder losses is leaking packrings in the piston, due to improper fit in the cylinor faulty joints, which allow steam to blow through n the admission end past the piston and rings to the ıust side, and out through the exhaust port without ıg any useful work. The cause of leaking pistons ıot always be wholly prevented, owing to the cylinbeing badly scored or worn, but in the majority of s they can be remedied to a great extent.

requently packing rings are found to be too small the cylinder bore, in which case they should be set by either tightening the setting out bolts or peening, ircumstances may determine. In order to spread a by peening, its inside circumference should receive ccession of hammer blows from the ball or peen of hammer, around its entire length, striking as nearly center of the ring as is possible and at equal dises apart. If this is not done the ring is apt to take form of a spiral. If it does it will not fit the joint ›erly and will be liable to stick in going over differportions of the cylinder surface if there is a differ: in its diameter.

is not necessary to make the ring larger than the ıder to any great extent, as most piston rings have ngs to assist them in making a tight joint. For s of small bore up to 4 inches, they should not be e than 1-32-inch larger than the bore; from 4 to 8 es not more than 3-64-inch; from 8 to 12 inches -inch; from 12 to 16 inches 3-32-inch, and from 16 o inches, ⅛-inch larger.

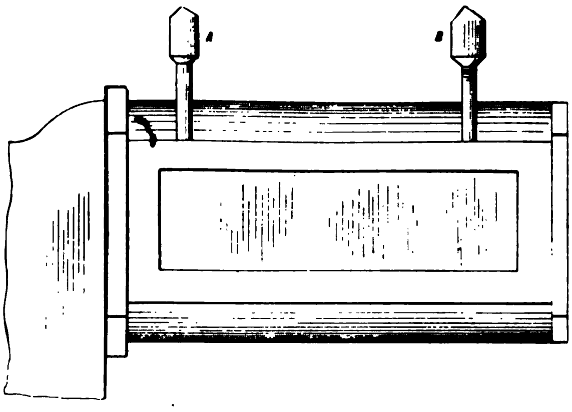
would hardly seem necessary to advocate the perial inspection of cylinders to ascertain whether the ɔn has lost its alignment or not, but this is a duty is neglected by many engineers. Quite frequently piston is out of line due to wear or other causes. ɜn the cylinder has been cut, follower bolts worked e or fractured and shoulders formed on the end of bore from improperly lining the connecting rod. nder oil often causes deterioration of the cylinder, to the acid which it contains. Thus it will be seen that there is a crying demand from the engine that the engineer examine it from time to time, in order that he may know exactly the condition it is in.

More than one cylinder head has been broken because a follower bolt has broken off and fallen down in the clearance space. Follower bolts lose much of their original strength, from crystalization caused by alternate cooling and heating. When this has occurred enough times a small strain will sometimes fracture a bolt that has been in use for many years. Some engineers renew the follower bolts in their engines at stated intervals, which is a highly commendable practice.

When tightening up follower bolts, either new or when they have been taken out and are being replaced, the best method of bringing them up to a bearing and putting a strain on them, is to first bring up one bolt so that it has a bearing and do the same to the opposite bolt. Continue in a circle round the set and tighten evenly upon all the bolts in rotation. C. E. T.

Cylinder Heat.

Some time ago I was offered a 10-horsepower gas engine at a figure that was but little more than old junk price. I knew the engine could hardly have been worn out in the time it had been used, even with the worst of care, and it was apparently in good condition. The paint on the cylinder was blistered a little, but I thought nothing of that at the time, as I had often seen a gas jet burning under a cylinder in cold weather, to prevent cracking of the metal from the great and sudden change of temperature when starting.



POSITION OF OIL CUPS.

I started the engine which ran very smoothly except for a slight scraping sound in the cylinder, which I supposed would stop after the different parts had warmed up and become oiled.

Picking up a piece of 2 x 4-inch timber about 5 feet long, and using it as a lever brake under the rim of one of the flywheels, I was surprised to find that the engine was giving but a small fraction of its nominal horsepower and very little pressure on the end of the lever was required to slow it down.

I made a more careful examination and found that a distance piece had been placed behind a piece of the igniting mechanism in such a manner that the spark could not be properly timed. I removed this and again trying the brake found that the engine gave what I considered fairly good power.

I bought the engine and soon had it set up. It had run but a short time under load when it began to slow up and the smell of burnt oil filled the room. Quickly shutting the engine down, I found the cylinder very hot, though the water was coming out of the cylinder only moderately warm. On examining the piston I found the rings were cutting the sides of the cylinder in spots, and parts of the metal packing rings of the piston had purple streaks on them, showing that they had been very hot.

After filing the edges off the rings so that they would not scrape the oil off the cylinder, nor have a cutting edge I tried the engine again. It worked much better, but still heated after running awhile. I then took the head off and found the water jacket almost entirely filled with a deposit resembling boiler scale. After thoroughly cleaning this out the engine ran as nicely as any engine I ever saw. The person who had doctored the igniter had made the spark late so the explosion would not cause so much heat, instead of cleaning the jacket when dirty as he should have done.

Cylinders of gas engines will also heat by being out of line, and by insufficient lubrication. One engine I was called on to repair, had the oiler placed too far forward on the cylinder as at *A*, in the illustration. I drilled a hole through the cylinder and jacket walls at *B*, and tapped it with a plug tap and screwed in a nipple of extra heavy ⅛-inch pipe. I was careful to file and emery off the end of the pipe that protruded into the cylinder and remove the filings. I then screwed on the oiler and the engine gave no more trouble.

Royal Wolfe.

A Crank Disk Wiper—Cracked Crosshead.

It isn't every engine room that is equipped in an up-to-date manner. A good many engine rooms having first-class equipment are lacking in some of the minor details, such as oil guards, etc. Consequently directly in line with the eccentrics and crank disk, the floor is saturated with oil, and if the engine is near the wall, the marks of flying oil are shown.

A little device which will help matters to a great extent is shown in Fig. 1. I saw this attached to an engine while visiting a steam plant a few days ago. It is a small angle arm attached to the engine frame, having a piece of stiff felt so arranged that it rubs against the face of the crank disk. As the oil is wiped from the disk by the felt, it cannot of course be thrown on the floor or adjoining wall, but drips into a pan under the *disk*. This scheme, although simple, is a good one.

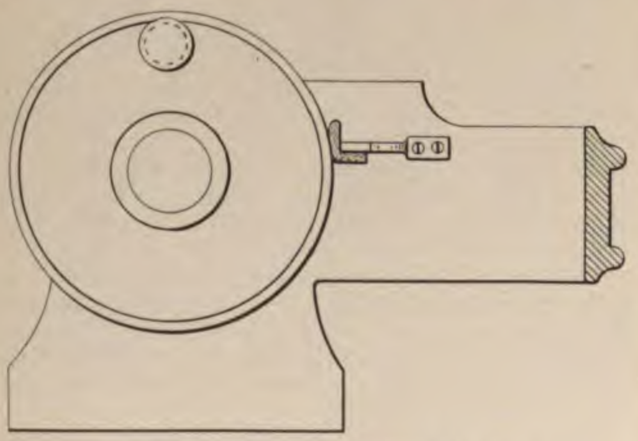


FIG. 1. WIPER FOR CRANK DISK.

epower per hour. This high steam consumption is ely attributed to the fact that it is very hard to keep valves tight. If it were possible to do so, the steam umption could be reduced to 32 pounds of dry n per hour.

nother type of engine is that of the automatic class ng two valves. In engines up to 100-horsepower cutting off at ¼-stroke, having a mean effective sure of 40 pounds, the steam consumption will be it 35 pounds per horsepower per hour. This can be iced to 32 pounds per hour when the valves are tight dry steam is available.

he Corliss type of automatic engines having a mean ctive pressure of 40 pounds, cutting off at from 1-5 ¼-stroke, will average about 30 pounds of steam per epower per hour for engines under 200-horsepower. ne engine is above this size the steam consumption be about 27 pounds of steam per horsepower per r. If the valves could be kept perfectly tight the m consumption could be reduced to as low as 24 nds.

he above is for single cylinder engines operating condensing. If the engines were compounded the m consumption would be reduced to about 27 pounds team per horsepower per hour.

the engines are to operate condensing the steam sumption will be reduced for engines of the same , over that mentioned above. An automatic cutoff ne of the Corliss type of 200-horsepower and over, require with a mean effective pressure of 40 pounds eam consumption of about 20 pounds per indicated sepower, cutting off at 1-5-stroke. The compound ine of the high speed automatic type will require it 19 pounds of steam per horsepower per hour, n the mean effective pressure is 30 pounds.

ompound automatic engines of the Corliss type hav- a mean effective pressure of 18 to 19 pounds per ire inch, with engines of 400-horsepower, will re- e about 15 or 17 pounds of steam per horsepower hour.

he expansions of steam will, of course, influence the m consumption. The more expansions there are the steam will be required to produce a horsepower. ny engineers do not know how the number of ex- sions are figured and in order that those who are in dark regarding the matter may understand, the fol- ing will put them right: If an engine receives steam gage pressure of 150 pounds or a pressure of 165 olute and the absolute terminal pressure is 10 nds, the number of expansions will be 165 ÷ 10 = expansions.

his and the ratio of expansion is frequently mixed, there is quite a difference between them. The ratio expansion of an engine is found by dividing the ke of the engine in inches by the number of inches eled by the piston to the point of cutoff. If an ine has a stroke of 40 inches, and the point of cutoff 4, the ratio of expansion will be 40 ÷ 4 = 10, the ies the piston has traveled at the point of cutoff. stroke of the engine divided by the distance the pis- has traveled equals 40 ÷ 10 = 4, the ratio of ex- sion.

W. F. Hemyer.

Getting Engines Off the Center.

o the engineer with a small engine, the matter of ting it on the dead center does not bother him very ch, as all he has to do is to step on a spoke of the fly- eel and the engine is ready to start. With larger ines, however, of say 100-horsepower and up, the standing on the spoke of the flywheel does not answer, and other means must be used.

In Fig. 1 is shown a starting bar, which is made to fit on the rim of the flywheel and with the leverage thus obtained there is no trouble in getting an engine, of say 100-horsepower, off the center, or even a 200 and 300-horsepower engine, if of the high speed type. This is much more convenient than the old fashioned way of getting a block and a piece of timber and prying the engine over a little at a time.

When the engine is large, however, even the wrench shown in Fig. 1 will not answer and another plan must be used. Fig. 2 shows a device which answers the purpose very satisfactorily with engines which are not too large. As shown, the clamp grips the rim of the wheel. This is connected to the long lever by the short link, the long lever being supported by a stand. It will be seen that as the long lever is forced down on the end by the engineer, the clamp grips the rim of the wheel and the engine is turned from the center. This makes a very handy way of getting an engine off the dead center and saves time as well as strong language.

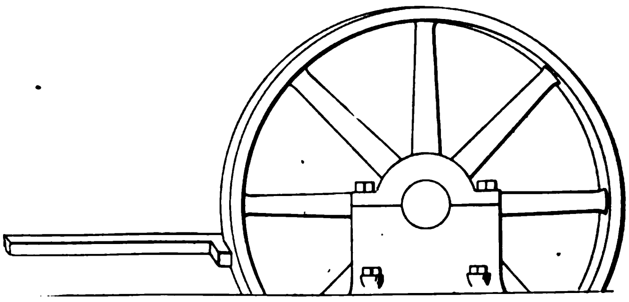


FIG. 1. DEVICE FOR GETTING A SMALL ENGINE OFF THE CENTER.

Some may say that there is very little need of stopping an engine on the center. I will admit that this is so, especially with four-valve engines, but the unexpected always happens. I have never placed an engine on the center in my life, when it didn't happen unexpectedly. Usually the engine gets on the center at a time when it will be the most difficult and bothersome to get it off. I remember at one plant in which I operated we had a four-valve engine and just as I was about to shut down one morning the superintendent came in. The engine didn't do a thing, but stop on the center. It was the first and only time that it did stop there while I ran the plant, which goes to show that things happen just when you don't want them to.

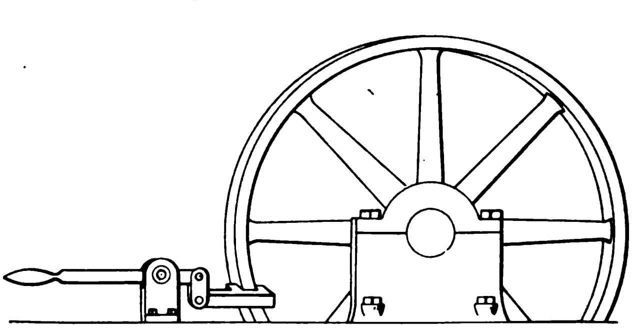


FIG. 2. DEVICE FOR GETTING A LARGE ENGINE OFF THE CENTER.

Anyone trying the above devices will find that they are of great convenience around the engine room.

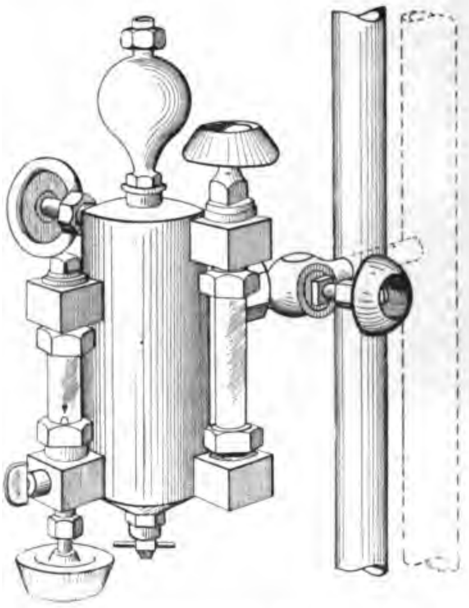
W. E. Stedman.

Thick Oil Caused Lubricator to Stop Feeding.

I have noticed in the Review several articles in regard to lubricators not feeding properly, and they recall a similar case that occurred in my plant a few years ago where the lubricator was attached to a four-valve engine. The sight glass choked up with oil, requiring frequent cleaning.

After considerable trouble I found that the stoppage of the sight feed glass was due to the oil being too thick which prevented its being fed at the required rate. Investigation along this line showed that with very thick oil, the drops are generally too large, and in trying to regulate the drops at so many per minute, the oil was fed in greater quantities than could flow through the horizontal connections to the steam pipe.

This was proven to my satisfaction from the fact that immediately after blowing out the lubricator glass, and for some time after, the lubricator would work as it should, as the shank of the cup was then hot, which heated and thinned the oil, allowing it to flow freely, until the shank cooled down again.



CHANGED CONNECTION TO STEAM PIPE.

When the shank and the water in the glass were cooled down, the oil flowed very slowly into the steam pipe, and if it were fed any faster from the needle point than it flowed into the steam pipe, it clogged the connections to the latter. Oil when comparatively cold in a lubricator will feed quite freely from the needle point, due to the pressure of water in the condensing pipe and bulb, but when it is liberated in the sight feed glass and rises to the surface of the water, it is obliged to find its way to the steam pipe by gravity. Therefore, the slightest obstruction is sufficient to cause it to clog up.

I adopted two methods of overcoming trouble from the sight glass choking up. One was the purchase of a thinner oil which would feed more freely and the other, shortening the connection between the lubricator and the feed pipe. The illustration shows this connection, the dotted lines showing the original position of the lubricator.

E. W. Chester.

Bad Valve Setting—New Place for an Oil Filter.

The two indicator diagrams illustrated herewith were taken from a 12 x36-inch Corliss engine running at 88 revolutions per minute. The engine was not working satisfactorily and I was asked to set the valves. The card, Fig. 1, shows how the valves were set when the first card was taken.

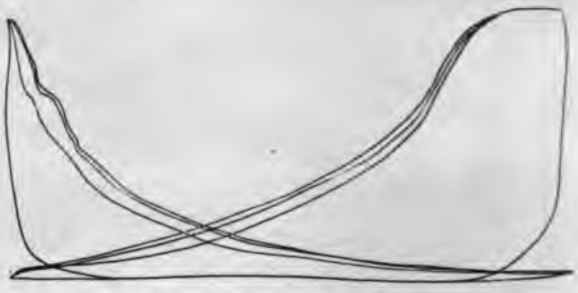


FIG. 1. HOW THE VALVES WERE SET.

I have just worked out and built a little kink which is very neat and handy. The head of the cylinder on the engine which I have charge of is covered with casing, held in place by one bolt in the center. I wanted a place for my oil filter, cans, etc., and so made a pattern and had a casting made which was secured to the cylinder head, as shown in Fig. 2.

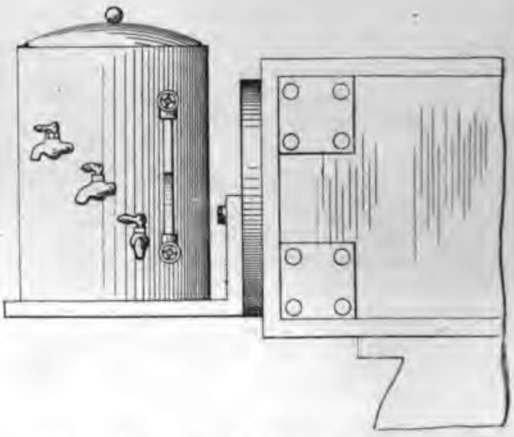


FIG. 2. OIL FILTER ON CYLINDER HEAD.

Jas. N. House.

Gas Engines as Compressors.

Having use for a small air compressor, I looked about for something to make one out of. I came across an automobile gasoline engine and concluded that it would be just the thing.

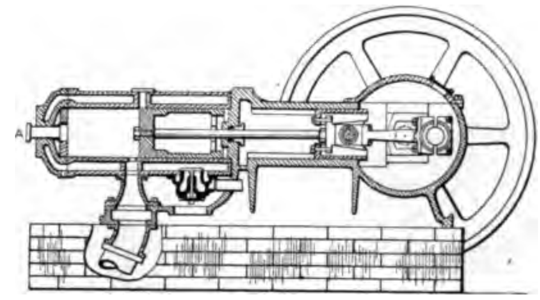
A hole was drilled and threaded through the head and a check valve screwed on as at *A*, Fig. 1. This completed the compressor, but the combustion chamber destroyed its efficiency.

A compressor must have small clearance, for the compressed air remaining in
to atmospheric pressure b
in, and by the time this h
travelled a good part of it

To remedy this troubl
behind the s

cing the clearance to a minimum. The block be-
the brass made it necessary to place longer bolts
ugh the crankpin brasses. The machine then gave
ect satisfaction.

ome time after this, I visited a large stone quarry.
y had just installed a larger engine in place of a
orsepower gas engine. The gas engine was in good



1. GAS ENGINE CONVERTED INTO AN AIR COMPRESSOR.

ition but as their supply of compressed air, used to
drills and hoisting engines, was too small, it was de-
d to purchase another compressor and run it with
small gas engine. I told them that I could make an
ompressor out of that engine at a cost of about $5.
y told me to go ahead and send in my bill.

ne engine for the purpose of starting had its com-
ion chamber connected to a tank containing com-
sed air. This pipe was closed at the engine by a
e valve, having an opening and closing lever at-
ed. I took off the "locking sheet" arrangement, and
tituted a coil spring in its place. The clearance
d not be reduced in this case by putting a block
nd the crankpin brass, on account of the spherical

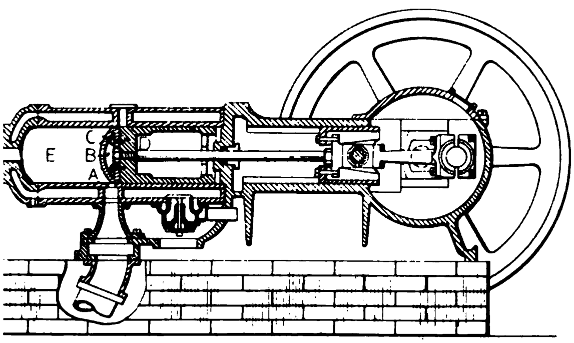


FIG. 2. FALSE HEAD BOLTED TO PISTON.

of the combustion chambers *E*. I had a hollow
isphere *B*, cast and bolted it on to the end of the
n with the balls *A* and *C*, packing the joint so no
ould get in, as shown in Fig. 2. The machine when
ed proved to be efficient and furnished all the air
ired.

R. W.

A Troublesome Gas Engine.

inking perhaps the experience a firm had with a
line engine would interest engineers I will relate
following: This firm required 4-horsepower
at times required 7 or 8 horsepower. Arti-
light was used in the basement 10 hours each
burning manufactured gas. A motor was also used
tervals during the day to run grinders and a drill-
nachine. Both gas and current were bought from
a lighting company. Another motor was used for power, but it was too small to fill the requirements, so they began looking around for some way of obtaining more power. A man selling gas engines dropped in about this time and after showing them (on paper) what large returns for the money invested they could realize if they put in a gas engine, he sold them a 10-horsepower engine and a generator large enough to carry 50 16-candlepower lights.

The cost of installing the machinery was practically nothing, their own men doing all the installation work except the electric wiring. They picked out one of their machine hands to become starter and stopper, as they were told by the agent that that was all the attention the engine required.

When everything was properly connected up the salesman took the new engineer one side and in about ten minutes imparted to him all the knowledge that was required.

The agent started up in the morning and everything went well until noon when they stopped the engine, but to start it again required several attempts. Every time it would not start the engineer made some adjustment and then tried again. In time he would hit the right combination and the engine would start. Sometimes he made so many adjustments that the agent was sent for, to come and put things back in their proper place, and then deal out another chunk of knowledge to the engineer.

The climax came one morning when the engineer could not start up. He thought the cooling water was leaking into the cylinder. To make certain he took off the cylinder head, and not seeing any, he thought it was too far back, and so took out the piston. Not finding any water after removing the piston, he started to put the piston back and in doing so broke the rings, and as it took a week to get new rings, the place was shut down and the engineer lost his job.

The agent, in the meantime, had left the company who sold the engine, so when the new rings came a new man arrived to fix things up. The piston was put into place and everything connected up. The current was turned on the igniter, a match put in the detonater, a charge pumped into the cylinder, and, bang, but the engine would not start. More adjustments were made, but still it would not move.

The new agent began to talk about heat units, specific gravity of gasoline, etc., but the engine would not start. In looking at the cam that works the igniter, he discovered water running out of the open end of the cylinder, which was found to be caused by an imperfect gasket on the cylinder head, which fault was remedied. Then with some exertion on the part of three strong men, one at each flywheel and one at the main belt, the engine was finally started. For the next week or two the starting pump was dispensed with and the new method used.

One morning about two weeks later the engine refused to start. The new engineer, after trying all the ways he had been told and some that he had not, discovered he was not getting any compression, but could not find the reason why. The agent not being in town, a man was sent for from an automobile livery, who discovered that the lever which holds the inlet valve closed when the exhaust valve is held open by the governor, had been caught in such a way as to hold the inlet valve closed, and by one o'clock they were ready to start. To make sure the trouble would not occur again the engineer bent the lever up out of the way, not knowing for what purpose it was used.

About this time they began to notice that the gasoline tank required filling more often. In looking up the figures they had been given they discovered they were using twice the amount of fuel they had expected to use. The agent was sent for, but after looking the engine over he could advance no explanation. When asked about the lever, he said it was all right. The batteries began to run down shortly after starting and the hot tube had to be put into use, which the agent could not account for.

A few more stops and delays happened for such causes as opening the throttle valve too wide, which caused the engine to run slow for one-half day, and the gasoline tank getting empty, which was not thought of until everything had been adjusted, and readjusted once more.

About this time the firm wrote to the manufacturers that if they did not fulfill their guarantee, they would throw the engine out and sue them for damages.

One morning a few days later a young fellow appeared at the office and represented himself as being sent by the manufacturers to straighten things out. He went down and looked at the engine and asked the engineer a few questions. He then had a talk with the firm, and went, away, but returned the next morning with tools and overalls. He also brought a man whom the firm engaged to look after the engine.

The young fellow started at the engine and if he was not an expert mechanic I never saw one. Every move that he made and the way he moved proved that. He went over the whole engine and there was not a part that did not need some attention. He found and explained the cause of all the trouble that they were having with the engine, and instructed the new man regarding the engine and had it ready to run at noon. He showed him how to start the engine so that one man could do it easily. That was about six months ago and from that time they have had no more shut downs or trouble.

It requires about 30 minutes to give it all the attention it requires in a day and it develops about 6-horsepower and consumes .66-gallon of gasoline per hour. Gasoline costs 10 cents per gallon. The repair in six months with proper attention has been practically nothing.

Besides furnishing the power required for the machine it runs the generator which furnishes current for about 25 16-candlepower lights continually, and what current is required to run the motor as well.

I never learned just what the saving is over the old system, but it must be quite an item as they do not have to buy any gas or current and have plenty of power.

The cost mentioned above is the average for seven months. The exact length of time that the engine runs and the amount of gasoline put into the tank is kept on record.

I think the above proves that no one should attempt to adjust a machine unless he fully understands all its parts.

J. F. B.

Gas Engines.

We have a 7-horsepower gas engine which was installed in 1895, and is, therefore, an old style engine compared with later designs. This engine is fitted with a side shaft driven from the crank shaft by a pair of worm gears. This shaft at the head end is fitted with a cam acting upon the lever *B*, Fig. 1, with a steel wheel *C* which opens the exhaust valve *D*. The timing of the exhaust is adjusted with a set screw and locknut *E*.

The exhaust valve gives the most trouble as it cuts through in a short time and is apt to leak first. The ease or efficiency with which the engine starts depends on the amount of leakage of the valve. It should be ground in once a month, by taking the valve cap off and uncoupling the spring *G*. The valve can then be lifted high enough to get emery and oil under it. A slot is also provided for a large brace screw driver. Put the bit into a brace and grind it in well. When the valve is coupled up again, and the valve cap is in place, call an assistant to help you, and if by lifting on the other side of the wheel and pulling backwards you cannot turn the wheel, it is tight enough.

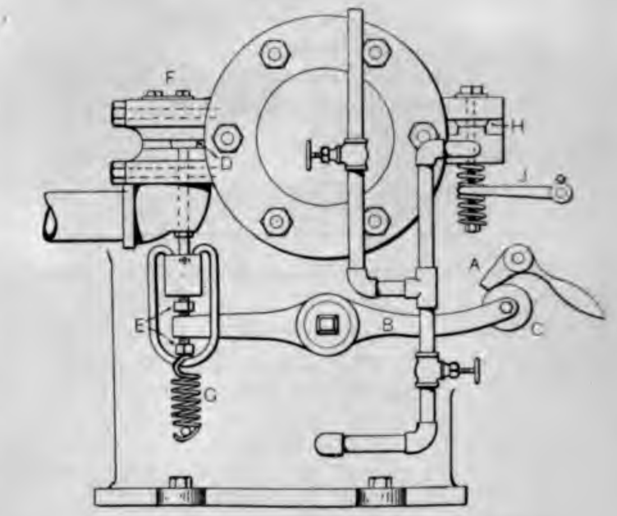


FIG. 1. SHOWING CAM LEVER AND VALVE.

The mixture of intake valve *H*, gives very little trouble and only needs grinding once a year, sometimes not even that often. This valve is raised by suction produced from the forward motion of the piston and as this suction stops, a light spiral spring, which is slipped over the stem above the governor arm *D*, holds the valve down on its seat. Below the governor arm *D*, is a short heavy spring. This arm is operated by a small shaft running along the side of the engine and attached to the ball and spring on the flywheel. As the engine increases in speed, the arm *J* is pressed down, cutting off part or all of the mixture from the cylinder.

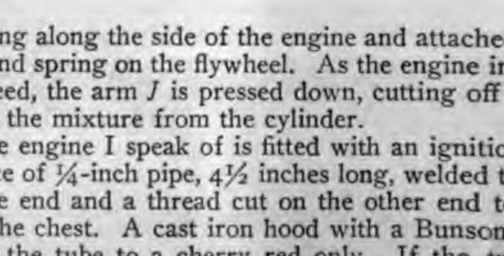


FIG. 2. LEVER WHICH REGULATES THE CHARGE.

The engine I speak of is fitted with an ignition tube; a piece of ¼-inch pipe, 4½ inches long, welded together at one end and a thread cut on the other end to screw into the chest. A cast iron hood with a Bunson burner heats the tube to a cherry red only. If the tube gets ı few degrees hotter, the engine will explode on ɔwn center and run backward a half turn instead the center.

w a word about these igniting tubes. They must ıanged every two weeks, because the heat and ıre from the inside at each explosion bulges the ; to such an extent that in two or three weeks they ılow out. Asbestos paper is used for gaskets as ırts get very hot. The gaskets are cut from sheets nch thick and are soaked in linseed oil. Care be taken not to tear the paper in the least, as the between the cylinder and water jacket are only :h wide, and in some places less. I have had good s from fresh white lead spread very thinly on both of the asbestos paper and then tightened when the e was a little warmer.

other important thing is the lubrication of the cyl- . If a poor grade of cylinder oil is used, it will and gum the rings and surface of the cylinder and ı, so that a large per cent of the power is wasted ction of the parts. Sometimes the cup will stop ıg and then the force of the explosion will blow he rings. If it is not stopped in a few hours the ler will be in a fair way to be rebored.

ıen an engine is installed, look at the gas and air s, count the number of turns of each valve, and 's run the engine with the same number of turns, is is the way the valves are left after the final test e the engine is sent out. The only variation of this ıe in the starting of the engine and this only on one , which is the gas valve, the wheel of which should rned only about ¼-inch. In starting, draw in the ;e and raise the release lever so that the cam *C*, n in Fig. 2, can pass from a position looking at gure from bottom to top, making a ¼ turn. .ving done this, put one foot on the spoke of the .eel, throwing your weight on it at the same time. hold of the rim of the wheel, pulling back, making ıd compression and be careful to remove your foot off the wheel. The charge will ignite and the en- is started. Gradually open the gas valve from ⅛ of a whole turn of the wheel, or to the points in- ɜd from the maker's test. This will be ample gas.

R. A. H.

Bags and Blisters.

ıny engineers refer to bags and blisters in the same ;, that is, they confuse a bag with a blister and then ı blister a bag. Whether this is from a lack of 'ledge or not is not known to the most of us, but it as if they didn't know the difference.

.ere is a distinction between a bag and a blister. ig. 1 is shown a section of boiler plate representing ; filled with scale. There is no need of going into ls regarding the formation of scale as all engineers e most limited experience know that scale is formed the impurities in the water, and if it is not cleaned ɔf the boiler, it will lodge in some particular part, f enough is allowed to accumulate the plate will be ɜd.

a general rule scale accumulates over the fur- It is easily seen that if this plate is not kept clean it will undoubtedly be burned. When the plate be- :s burned, the steam pressure in the boiler is so : and the strength of the plate has been weakened ıuch that that particular section of the plate will rced down as shown. When this occurs it is known bag.

ɡ. 2 shows a blister which has the appearance of a bag when looking from the outside of the plate, and there is no way of telling at first glance whether the plate is bagged or blistered. An examination of the interior surface of the plate will not always disclose the fact that it is a blister, because sometimes this surface is also indented, giving the appearance of a bag. By an examination of Fig. 2, it will be seen that a blister is altogether different from a bag, insomuch that while in the one, the entire thickness of the plate is affected in the latter only the outside surface may be down.

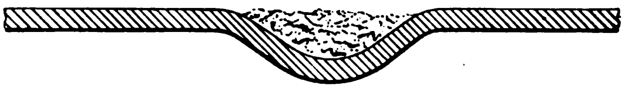


FIG. 1. A BAGGED PLATE.

When a plate blisters it separates, a layer detaching itself from the main part as shown. This is something which the engineer or fireman has nothing to do with whatever, and usually is a fault in the rolling of the plate by the manufacturer.

Another matter which seems to be confused in the minds of a good many engineers is that of tubes and flues. Only the other day while talking with an engineer he referred to the 3-inch tubes of his boiler as flues, and only a short time ago another engineer referred to a flue as a tube.

Doubtless the engineers would have been indignant had I corrected them, but I am sure that a good many engineers do not make a distinction, and in some instances I feel that they do not know that there is any difference.

As I understand the matter a tube in connection with boiler practice is under 6 inches in diameter, while a flue is embraced in all diameters above 6 inches. I have noticed many times in the technical press that this matter has been overlooked and often the 3 or 3½ or 4-inch tubes in a boiler are referred to as flues. It seems to me it would be just as correct and just as sensible to designate rivets as spikes and braces as bolts as to call the tube a flue or the flue a tube.

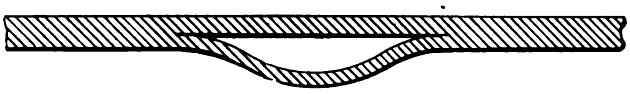


FIG. 2. A BLISTERED PLATE.

Owen Britton.

Boiler Plant Difficulties.

The chief engineer alone should be held responsible for the condition of all boilers in his charge. His wages should also be commensurate with the extent of the plant, and the duties demanded of him. All boiler owners are aware, that from a financial standpoint alone, it is essential that boilers should be regularly and thoroughly cleaned, also periodically inspected, either by a representative of the insurance company concerned, or the man who is employed for their supervision.

Who is bold enough to challenge my assertion, that if all boilers, in service for generating steam, have a daily blowing down, together with a monthly cleaning, bagged boilers would be a very rare occurrence? The chief should personally undertake the blowing down, and also thoroughly examine the interior and exterior of the boiler after cleaning. By doing this, he is seldom in doubt as to its condition, and his employers and assistants have cause to have more confidence in him. There are many plants, however, where the boiler capacity is wholy inadequate to warrant the lay-off of a boiler for proper cleaning and inspection. It is never satisfactory to let all the water out of a boiler for cleaning purposes and within a few hours, refill it. Yet, how often this practice, has of necessity to be resorted to, in order to have sufficient steam power to take care of the subsequent load.

Under these conditions, what opportunity has the engineer, to enable him to grind in leaky safety valves, blowoff and other valves connected with that section, also to examine the seams, plates and setting, clean out all scale and sediment from within and all soot and ashes outside the boiler?

Frequently we visit boiler rooms and find one or more boilers out of commission, condemned by everybody and monopolizing the space that a serviceable boiler should occupy. If boiler owners practically interested themselves in this matter by installing a spare boiler, built according to the most modern requirements, it would be a sound investment of capital and materially increase the value and profits of the plant.

It is essential that all owners of steam plants keep a first-class engineer, one who is strictly temperate, pay him good wages and give him the necessary supplies. The plant will then most surely get the proper care and management.
R. D. Fryer.

Emptying a Boiler While Hot.

Numerous articles have been written warning engineers of the many evil effects liable to occur by emptying steam boilers while the brick work is hot. Where I am employed there are three return tubular boilers, two of them always being in use. I generally blow out about an inch of water twice each day so as to keep any scale or sediment from collecting near the blowoff outlet, or stopping the pipe between the boiler and the blowoff cock.

There is only a few inches between the boiler brickwork and the wall, and as we did not believe in front blowoffs for various reasons we left it where it was and put the blowoff cock outside, but well protected from the frost with a double box. It never gave any trouble until one day the cover of the box was carelessly left open, which resulted in the whole side of the cock blowing out after being cracked by frost. As our spare boiler was in the hands of the repair men we were in a fix, but we had to have that boiler, so we emptied it as soon as the fire was pulled, put on a new cock and then filled it up and started a fire again as soon as we could, as there were a number of men idle while there was only one boiler running. In about an hour the repairs were completed.

In a few days steam was noticed coming out from several places around the rivets and on examination it was found that in four different places the iron plate had cracked for a distance of ¼-inch, on opposite sides of the rivets. We had to cut out the boiler for two days while the boilermakers put on four hard patches. Now I am convinced by experience that it is possible to do harm to a boiler by blowing off and filling up while hot. My opinion before had been that about the worst results to happen would have been baked sediment.
Jack D.

[Many engineers believe that it is dangerous to empty a boiler while hot, but such is not the case, as the setting and the boiler cool off together. Where there is mud or scale it will, of course, bake on, but as far as the injury to the boiler plate is concerned there will be none. If our contributor had allowed his boiler to cool before filling with cold water and had taken the time he ought in getting up steam there would not have been any cracked plate or leaky rivets. Emptying a boiler and getting up steam again in one short hour is treatment that will cause the best of boilers to leak, if no greater damage is done. It was the latter part of the proceedings that caused the damage, not the emptying while hot.—Editor.]

How to Handle Firemen.

Mr. Taylor called the other evening and Pop got to talking. Mr. Taylor asked Pop if he wasn't one of the engineers' gang on the Oregon and what he thought of the recent editorial "Cadet's Avoidance of Engineering Duty." Pop said that it just hit the nail exactly on the head, and continuing he said: "Did it ever occur to you to ask how a battleship that could only steam 17 knots, could catch a cruiser like the Colon that could steam 22 knots, which in an hour and a half should have left the Oregon five miles astern? It was simply a case of handling firemen and engines.

"After the fight, the Oregon took on board three wounded prisoners from the Colon, a seaman, a quartermaster, and a watertender. Being able to speak a little Spanish, I talked to the watertender.

"He told me that a good many of the firemen had been ashore the day before the fight and filled up with wine. Then when they were shut up in the fire room and the forced draft on, the intense heat soon played them out. When they wanted to go on deck and get a breath of air the engineers stood at the foot of the ladder and drove them back to the firerooms with their pistols. He saw four of the firemen shot down like dogs by their own engineers, for insisting on going up to get a breath. They were soon so exhausted that they didn't seem to care whether they were shot down or not. Of course the steam dropped down lower and lower as the firemen dropped out.

"On the Oregon, Engineer R—— who was in charge of the fireroom during the fight, passed the word along that one man from each fireroom should go on deck at a time, get a breath of air, a look around, and then tumble down again and go to work while another one took a breath. They kept it up till noon when the first division of firemen and coal passers were called down from the deck, where they had been handling the powder hoists, to change places with the firemen of the second division. And say, being fresh on fires they just went after her like devils and didn't do a thing but jump the steam up 30 pounds.

"Although the fireroom always had a double crew of firemen during the fight, the engineers, machinists and watertenders would all grab a slice bar and poke up the fires, and even send the men up to the doctor to get a drink of whiskey. They treated the men like men, and not like the Spaniards treated their firemen, worse than dogs. When I was called down in the starboard engine room to relieve chief machinist Johnson, who had been handling that engine all morning, the steam was climbing up and soon that 5,000-horsepower engine was turning her 137 revolutions per minute, with McCarthy on the port engine, keeping step to a dot. And when you see two 5,000-horsepower engines turning at 137 and doing it like a pair of watches, you won't forget it soon.

l as for Captain—now Admiral—Clark, why,
ıe chase was over he called for and led in three
and a tiger for the 'black gang,' as the engineers'
ꞩ called, and then told them all to go down and
doctor and for him not to make them small ones,
showed that Admiral Clark appreciated the work
engineers' force, if the journalists and historians

v take that boy of mine. Knowing the navy as
uppose I get him an appointment to Annapolis,
I tell him to take an engineer's course? That
condemn him to eight hours a day for the best
his life in one of those pot holes where the tem-
e is from 120 to 140 degrees and at the end, to
below where he would have been by far less
and always on deck in the fresh air with clean
, gold lace and buttons and praise instead of
grease, oil and overalls.
/ou want results from your firemen, treat them
n. Give them all the light and air you can. It
rprise you how the steam stays up when the fire-
els good.
st assistant engineer Awfully had entire super-
of both engine rooms, and received all the blame
thing that went wrong, while Chief Milligan got
credit for doing well." An Engineer at Home.

Valves Leaked.

other morning the boss came around and said:
ts all how other mills can run on their waste fuel
re we are burning a car load of coal every three
months."
d him that the reason was because the valves
but he couldn't see it that way as they had been
ıp two years before. With that he turned and
engine room mumbling to himself. Things went
ell for two or three days, when he came in one
ıg and said: "I think I could run this mill on
ste alone." I told him his chances were good, so
bbed the shovel and started to fire. He told me
ch the engine and pumps and he would fire the

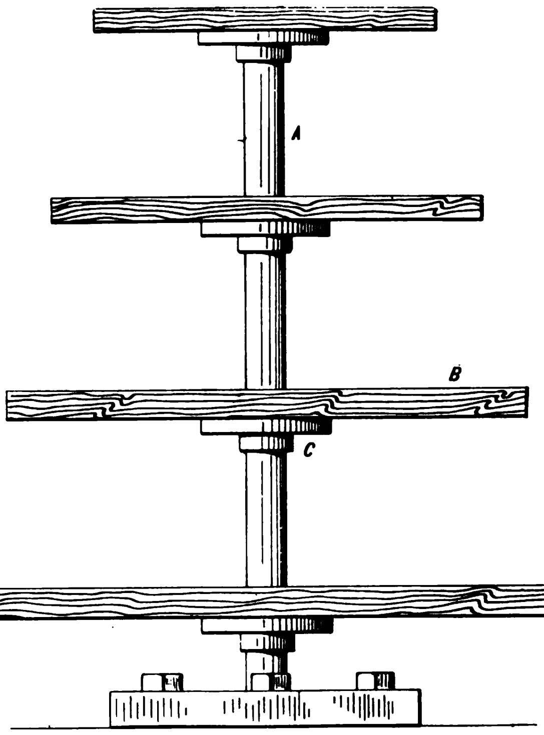
as laughable to see the old man firing; he would
a fire and then monkey with the drafts in the
flue; then throw in another fire and then watch
am gage for a minute or two and then work the
draft for a while. He was first from one draft
her, but of no avail. I came out of the engine
nd told him that the steam was going down, but
er let on he heard me. It was not long till I saw
man at the coal pile. He would put in a shovel
and then slam the door as usual and then take
ıt at the steam gage. Of course all this time I
e pump on and the water was up pretty well in
ss. He thought that if I did not have the pump
the time it would fire a lot easier. I encouraged
telling him I thought he was burning more fuel
did, but he didn't see how that was.
n turned and went in the engine room, and put on
ector to fill up the tank in the engine room with
and put on the pump again. It was not long be-
ıe old man was scratching his head, and as he
off his specks to wipe the dust off the glasses,
"There is something seriously wrong. You had
take the shovel, as I have got to go to the office,"
left.
bout two days an engine expert arrived and had
with me. I told him the shape the engine was in
e shut down the plant, took out the valves and it would open your eyes to see the condition they were in. We sent them to the shop and in the course of three or four days they came back, and I have had no trouble since.

N. Lloyd.

Tool Tree for the Engine Room.

What I call my tool tree, upon which wrenches, hammers and all kinds of tools can be placed and kept out of the way, is shown in the illustration. For my part I think it as ornamental and as useful as a tool board and far more so than the average tool chest which a man has to hunt all through when he wants to find any particular tool, unless it is so large he cannot help but see it.

My tool tree consists of an iron base bolted to the floor in a convenient place, having an upright post of 1¼-inch pipe in diameter. On this upright piece, five round shelves are secured by set screws upon which the tools may be placed.



TOOL TREE.

Each shelf is made of wood turned out the desired size, to which is bolted, on the under side, a floor flange which has been drilled out large enough to slip over 1¼-inch pipe. In the hub of the flange a set screw is placed, to secure it to the upright pipe at whatever height is desired. This makes a convenient tool tree for such engine rooms, where it is safe to allow the tools to be exposed. It will not be of much use, however, if Tom, Dick and Harry are allowed to come into the engine room to get whatever they want.

S. S. F.

Has the Old Style Water Columns.

I have been reading the Engineers' Review for several years and find in it a valuable paper for engineers to read, but some of the letters published are a little off color. There is one subject in particular, the safety water columns. The water column for me is the very simplest kind that can be had, the old style barrel with roomy connections are the kind I have used for years and I have never had an accident with any of them.

My firemen are given to understand they are to carry a certain pressure, and water at a certain level or nearly so. Some may say this can not be done. I say it can, and is the only way a plant should be run.

The plant I have charge of runs 24 hours a day and six days a week. We start up at seven o'clock Monday morning, and by eight o'clock the full load is on, and it does not take very long to get things regulated to the load. Our water supply to the pumps is regulated automatically and the feed pumps are set so they will supply the boilers and keep water at a certain level all the time. Our pumps are not stopped during the 144 hours continuous running and we are always pretty sure of knowing our water is not getting low without having to wait for a whistle to notify us of the fact.

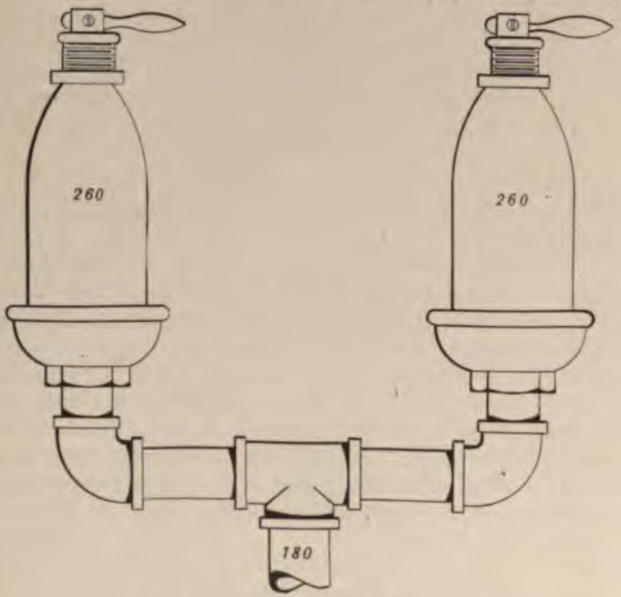
This thing of allowing a fireman to sit around and read a five cent novel, or gossip with every one in the neighborhood, until the alarm sounds, is criminal carelessness, and should be stopped at once. Some may say a plant cannot be run as I have stated, but I say it can and it is the only way it should be run, if you want to get good results and be on the safe side.

Every engineer should have a system to work by and see that it is lived up to. I make it a rule to go through my engine room every 15 minutes, also take a look in the boiler room on my rounds. If a man knows his business, he can tell at a glance how things are going. It is very seldom we have to stop during the week and as to fuel and repair bills, we have a reputation that is very hard to beat, but we use the old style water columns, keep them in good order, and they can be relied upon.

W. P. Brooks.

Another Safety Valve Problem.

Having read with interest the articles and comments on the Safety Valve Puzzle, I would like to tell of an experience I had with safety valves while engaged in the steam automobile business a few years ago and get the opinion of other readers of the Review on the subject.



ANOTHER ARRANGEMENT OF SAFETY VALVES.

It happened that one of our customers, being some-vere thinking about when they wrote the letter, ey had their opinion of him, which wouldn't look print.

ought this was bad enough, but the editor got an and asked me what the fellow was talking about. ed it over, but I couldn't make out what the fellas getting at after the first few lines. There a period or any other kind of punctuation. I for a sentence but there was none, not even a letter to tell where it ought to start. I made mind that the editor must be an expert at mind g in order to know what them fellers wanted to and tell others about.

editor says that the great trouble with fellers ant to write is that they won't let themselves be l, but just as soon as they find that there is a for their letters to be published they begin to that they are space writers and start in to fill up nything handy that comes to mind.

showed me a letter from a feller that didn't t to much although there was plenty of it. This began at the beginning of the book and started in whether the letters and articles meet with his al or not. It read something like this: "The letW. A. Leonard in the Nov. No. seems to be O. K. tter by D. R. McL same issue don't amount to Compression is old and no one cares anything it anyway. Mr. Cooley's safety valve will blow 200 pounds pressure," and that was about the way ole letter ran.

D HIM I HAD A LITTLE ARTICLE ON OVERTIME WORK
D AS HE READ IT I GOT INTO AN EASY POSITION."

editor said that he would have to send that letter is it wasn't up to the standard and that there nore of the same sort to attend to.

le there the editor had about half a dozen calls "phone," as the fairy called it, and he had to talk eller about this and that, which took up his time ine too. Finally I told him that I thought I had ed him enough and as he didn't contradict me I he thought so too. After he had shaken hands sured me that my letter would be printed I left nd as I passed out I heard the little fairy say to a who was sittin in the outer office, "your next." I roubles of my own, but I guess the editor has es the same as the rest of us. Bill B. Banger.

Caleb Visits the Country.

ve been on a visit down east. A few days after there I saw some men moving a small upright engine and boiler which was to run a threshing machine, so I just looked on. Jim, one of the engineers, got the engine set and the next thing was water. There was no water glass and the gage cocks were plugged up with sticks, because Jim said they leaked. Jim filled the boiler up and figured he could tell about how long it would take to get empty, but he put in a fire before filling and warmed it up so it wouldn't take so long to get up steam. Steam was got up at last and Jim tried to start up to see how things worked for said he: "The old girl hadn't been run for a year."

When he tried to start something was wrong and Jeff said "Jim didn't know how to start the engine." They pulled it around by hand for half an hour and then Jim wanted a crowbar. He got it and pried under the crank disk and got it under the safety valve lever, but it wouldn't go. Finally Jim gave it up and Jeff took hold. Jeff told Jim "he would run it or bust it," so he got the crowbar again and this time he got it behind the governors and gave it a yank that settled it for off went the governors and steam flew and so did Jim and all the rest of us. They made up their minds to thresh by hand and all because they didn't know that the governor was stuck on the seat. Caleb.

Safety Valves—Condensing Pipes.

I see that the controversy over the pressure required to operate two safety valves has apparently been settled as when a thing has been proven by actual experiments. as has been done in the case of the safety valves, there can be little more said upon the subject. The pressure required to operate the second valve has been found to be about twice that required to operate the first valve.

One thing which has been overlooked in the arguments of those who have written on the subject is that the valve will have a greater area on the top than on the bottom side, which is exposed to the pressure of the steam in the boiler. Take for instance a valve on a boiler having a grate area of 30 square feet, the safety valve would require an area of 15 square inches, which is equal to a diameter of about 4.4-inch on the under side. The pressure exerted against this surface would be $15 \times 100 = 1{,}500$ pounds if the boiler were carrying a pressure of 100 pounds to square inch. The outside or upper area with such a valve would not be less than 5 inches in diameter and would have an area of 19.63 inches. The pressure exerted upon this area would be $19.63 \times 100 = 1{,}963$ pounds or a difference in the pressure on the two sides of the valve of $1{,}963 - 1{,}500 = 463$ pounds.

This would certainly have some effect upon the operation of the valve and shows at once that the second valve could not operate at the same pressure that the first one does.

I fail to see how the cooling of the condensed water in the condensing pipe of a lubricator can have any effect upon the feeding of the oil, as claimed by H. D. in the November issue. In my experience the water gets cool in any case, unless the room is exceedingly hot, and even then it gets considerably cooler than the room. I cannot see where cutting off the length of the pipe will prevent the water from cooling the same as before, as it will be exposed to the cooling effects of the room just the same. If there is not enough head in the condensing pipe it is certain that the oil will not feed as it should, because this is the real reason why the oil will feed at all.

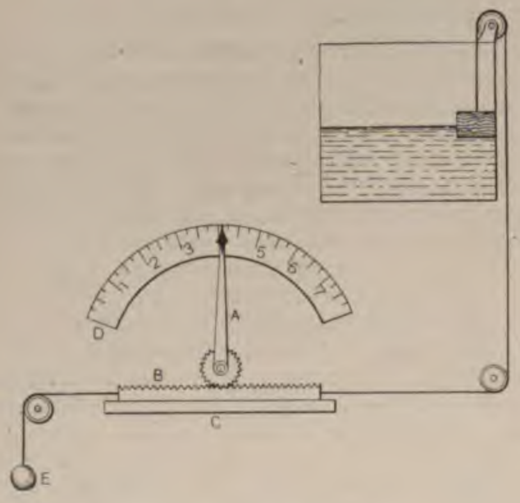
I could not but admire the ingenuity of F. W. H. in the arrangement of the fan used to keep his dynamo cool. It was a good thing to do for the time being, but it is not a device that speaks very highly for his discovering abilities. While make-shift arrangements are all right for emergencies, they are out of place when it comes to including them in the regular equipment of the plant.

I am sure that the author of that letter will agree with me when I say that it would have been better engineering on his part if he had persisted in his investigation and found the cause of the trouble. I would advise him to try to find out the trouble and discard the fan as soon as possible.
Fault Finder.

Water Level Indicator.

The illustration is of a tank gage which is in operation in my plant. It consists of a gear wheel set on a pinion to which is attached the hand *A*. A rack gear *B*, meshes into the gear wheel as shown and slides on the seat *C*. A dial is constructed as shown, having as many inches marked on it as it is desired to allow the water to fluctuate up and down in the tank; in my case 7 inches.

It will be seen that as the float in the tank falls it will draw the rack gear toward the right, causing the hand *A*, to move toward the left, indicating that the water is falling. When the water rises in the tank the float also rises, allowing the weight *E*, to draw the rack toward the left, thus reversing the movement of the hand, which motion continues until the tank is full and the pointer points at 7. By means of this the water in the tank is shown on the dial, which is placed in a convenient place in the engine room.



WATER LEVEL INDICATOR.

This same idea could be used with tanks which were frequently emptied, but the movement of the rack would have to be reduced by means of a reducing motion to coincide with the movement of the float.
T. C. E.

Thinks There is Danger From Open Heaters.

Although there are a great many open heaters in successful operation there is no doubt but what they are responsible for a great many cases of burnt and bulged fire sheets in boilers. Where an open heater is in use taking exhaust steam from an engine, the feedwater will be contaminated by grease and oil. As the feedwater is churned up with the exhaust steam, the oil is held in solution, consequently it is a very hard matter even with any combination of strainers and grease extractors to get the heavy oil out. The engineer must be more or less on the anxious seat all of the time, and it seems that a settling tank is the only remedy to remove all of the oil, as with the tank the oil can be skimmed off the top of the water. The objection to this is, that the feedwater will lose the heat that would otherwise go to the boiler.

Some circumstances may delay this danger of burnt plates from an open heater for a considerable time, but there is always a doubt when that limit is reached. Boilers in the limestone region are partially immune from this danger, due to the fact that the lime absorbs the oil and holds it in suspension in small particles, which are readily removed at the blowoff valve. I have seen boilers in the same districts with plates so badly burnt and damaged as to cause extensive repairs. A closed heater obviates this danger as the exhaust steam and feedwater do not mingle. More water for evaporation will be required owing to the loss of the exhaust steam, but the investment will amply pay for itself.
Thomas Grieve.

What a Few Changes Did.

I took charge of a steam plant a few years ago, in a Southern city, that contained one boiler of about 60 horsepower. The water was pumped into the boiler cold and six months was about the longest they could keep a fireman, and some only a few days. The engine was rated at 50 horsepower and was in good order, running at 165 revolutions a minute and was pulling about all it could at from 90 to 100 pounds pressure. If the steam dropped to 85 pounds the engine began to slow down.

They had considerable sawdust, shavings, waste blocks, etc., from the factory, which were burned in connection with dry pine cord wood. Even with this kind of fuel, when it got wet it was hard to hold the steam and at times some of the machines were taken off.

I told the superintendent, who was one of the owners, that by putting in a feedwater heater we could keep up steam with what waste fuel came from the factory. He replied he wouldn't do any such thing because the other engineer had said all the saving we could make wouldn't pay to put in a heater, as one would cost from $200 to $300 by the time it was connected up, and with this he left me. I just thought to myself that the superintendent and engineer didn't know much about heaters.

The next day I noticed that there were several square feet more grate surface than necessary. It was a horizontal tubular boiler with double doors in the fire box. There was a space of 14 inches from the edge of the doorway to the brick wall on either side of the furnace which left corners for air holes, and any engineer or fireman knows that those corners would be hard to keep fuel in.

I also noticed that when the engine was running with 85 pounds steam pressure it was running on too slow a speed. I thought by reducing the diameter of the pulley on the line shaft and speeding the engine up to about 190 or 200 revolutions it would pull the load much easier. As the engine was only of 12-inch stroke, it could stand it to run that fast.

When the boss came around I told him about the furnace and how I could make it better, and how by changing the pulley on the line shaft to a smaller one, I would get more power. He replied that he had changed pulleys ɔut eight or nine years ago from a smaller one er one, as the engineer said the engine was runter than there was any call for.

:d him if he hadn't put on more machines and :ted he had. He told me the pulley which was f was in the warehouse and to look at it and if ıt it would help out, to put it on. I examined it, diameter and got the speed indicator, took the the line shaft and measured the diameter of the ıulley and found I could run the line shaft the ɜed after changing pulleys, by running the en-194 revolutions. I got the pulley ready and it take an hour to put it on. The next day I the engine up until we had the required speed ıe shaft. Then we watched the difference. We team go down until the engine began to slow hich was 64 pounds.

oss was pretty well pleased with that change, ittle while he came around and we got to talkıt a heater and about what I thought the saving e. I told him we burned, on an average, 2½ 4-foot wood a week, which costs $3.50 a cord, ould be $8.75 a week. I felt safe to say that save that much or more. "But," said he, "a osts more money than I care to pay out." I him to figure it up at $8.75 a week and see how vould be until it paid for itself. He went away, r my theory about saving so much wood, I think, he course of a couple of hours he dropped in ıd said: "I've been thinking this thing over heater and I believe I'll go down and look the different factories and machine shops and :an find a second-hand heater cheap that we can ıd make it do all right."

ext day he went out and found one he could get and had me go and look at it. It was a cast ll, 5 feet long, 20 inches in diameter inside, with eads, and no water pipe. I had water pipe conmade in each end by tapping into one head and :he pipe screw through from the inside with a ıus thread of about 5 inches so as to make conto the boiler. Then I put 11 1¼-inch pipes 4 g, lengthwise of the heater, with bends. The t came through the bottom end to connect to the ıd continuous threads the same as the top end, hole in the shell was large enough so that the ıped through and we put a locknut on the pipe :r side of the shell. The exhaust pipe entered enter in the bottom and came out at the center ɔp. Well, we got everything all ready and shut ne day and connected it up. The heater and er pipes together cost about $20. I also reduced e surface 12 inches on either side of the furnace, ıcing at the bottom of the ashpit and building up to about 11 inches of boiler, with fire brick, n tapered it to the old wall. That brought the nches from the door way on either side of the , which left 4 feet crosswise of furnace. The vere 5 feet long which made 20 square feet of ırface. I did not figure the heating surface to had the proper grate surface, but just concluded ooks of it that the furnace was too wide.

ıext day we started the heater going and everyorked all right. The fireman couldn't keep the :om blowing off for a while until he got used to conditions and he had a snap at $2 a day. When y night, came, however, he was laid off, and the ·ed a boy to fire at 75 cents a day. We run in y for a couple of weeks and I watched closely the amount of fuel we used. The result was, that no more cord wood was used and the wasted fuel from the factory began to accumulate, of which they sold one load for $2.

The saving was 2½ cords of wood ($8.75), $2 for fuel sold and $1.25 on the fireman, a total of $12 a week. Fifty-two weeks in a year would make it $624; enough to buy several heaters for that sized plant. I have no doubt there are other steam plants running in a similar condition.

A. L. J.

Is This Economical Operation?

I have charge of a new steam plant consisting of a cross compound engine, with cylinders 22 and 46 x 48 inches. It runs at 85 revolutions per minute, and is connected to an independent jet condenser and an open heater. Two water tube boilers, rated at 428-horsepower each, furnish the steam.

We have three men on an 8-hour watch in the fireroom, and two engineers beside myself, making a total of 12 men. We burn soft coal and screenings and carry a load of 970 indicated horsepower. The cost of fuel and labor, myself included, is 36-100 of a cent in producing 1 horsepower for 1 hour.

I will say that I have not run a regular duty test in determining the above, but every pound of coal we used was weighed before it went into the furnace. The amount used every 24 hours was entered in a book kept for that purpose, and the indicated horsepower of the engine for the same 24 hours was entered on the same page. Thus I can show the amount of coal per horsepower per hour used each day. Following are the figures for a six days' run of 24 hours each:

Sept.	4	—Started up 8 a. m., weighed in for firing up	15,405
"	5	—24 hours run 8 a. m., " " as needed	64,345
"	6	—" " " 8 a. m., " " " "	61,266
"	7	—" " " 8 a. m., " " " "	61,255
"	8	—" " " 8 a. m., " " " "	56,097
"	9	—" " " 8 a. m., " " " "	61,698
"	10	—Shut down at 8 a. m., cleaned up the floor	44,350

Continuous run, 144 hours, pounds of coal used, total 364,416.

The average indicated horsepower delivered daily was 922. The wages of all the help in this plant amount to $20.98 per 24 hours. The coal was Illinois pea and slack. Soft coal costs $1.90 per ton, delivered at the mill. The average amount of coal used on this run, per horsepower per hour, was 2.74 pounds, which with the wages, makes the cost per horsepower per hour, .3543 or approximately 36-100 of 1 cent, which, as far as I know is a very good result. I would like very much to hear what other engineers are doing along this line and would like to know what the actual cost of 1 horsepower for 1 hour should be to be considered good economy.

Chas. D. Bacon.

The Injector Would Not Work.

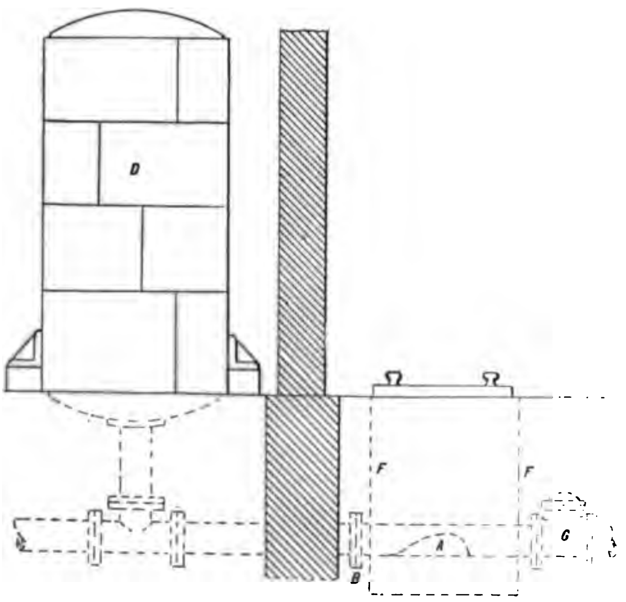
The following is an experience I had with a good reliable injector. It was on a small threshing engine and seeing there was some trouble going on as I came along, I walked over to investigate. The fire had been drawn the water was down and only 30 pounds of steam remained and they could not get water into the boiler because, as they said, the injector was no good. After looking it over and finding it, seemingly, in good repair I went over to the man in charge and asked him to give me a wrench to see if the trouble was with the injector, but he didn't want me to meddle with it. I told him that I would do it no harm and to convince him I handed him a five dollar bill, saying that if the injector was not working in 30 minutes, for him to keep it, and after a few minutes he consented.

I dipped part of the water out of the barrel and took the strainer of the hose in my hand and told him to turn on the steam and it worked all right, but when he tried the barrel it would not work. I took off my coat, rolled up one sleeve of my shirt, took the strainer in my hand and sent it down in the barrel as far as I could reach, and had him turn on the steam as before and it started, much to my delight.

When it got fairly well started, however, something struck me on the back of the hand holding the strainer, which proved to be a chunk of matted wool that had been brought from a near by creek where they got their feedwater. When the injector commenced to draw, the wool would come to the strainer and shut off the water and choke the feed. When steam was shut off the injector, the water in the hose ran back to the barrel and sent the wool away a little distance only to have it return again as soon as steam was turned on. He returned to me the $5 and I went my way, satisfied that I had saved a good injector from the scrap pile for a little while longer, at least. Philip Gillis.

Break in a Water Pipe.

A short time ago my attention was called to a break in the main discharge pipe at a water works plant. The plant consists of two cross compound pumping engines



SHOWING WHERE THE WATER PIPE BROKE.

of 4,000,000 gallons capacity, pumping direct into the main against a head of 255 feet. Four large tubular boilers supply these pumps with steam. At the time that the break occurred in the main, the pump on that *ine being in service* was shut down and the gate valve *closed and the air* released from the large tank ecause when the water is in circulation the .tter in it will certainly be in motion also, the boiler were at rest the deposits would ıce to settle to the bottom and be more read- off through the blowoff.

d to scale, there are numerous compounds prevent scale and remove it, yet there are ıre useless. I can't say anything about pota- ene, etc., because I have never tried them. a scaling powder now that does good work, oo much of it will cause the boiler to foam.

regard to banking. I have found out from that different methods of banking must be different grades of coal. With slack coal a over the fire is sufficient, but with lump coal e to put a layer over the fire it would all be before morning, besides raising the steam. do is as follows: I rake my fire over well, clinkers and close the drafts for about ten lowing the steam to drop about 20 pounds; about 200 pounds of coal in a kind of ridge f the dead plate and cover it with wet ashes. norning all I have to do is break this bank plenty of fire the steam having raised dur- ht to 80 or 90 pounds, the head I carry. This ıking lasts from Saturday at noon until Mon- ıg and sometimes longer.

thin firing is the best and I have tried all thin, quick fire is more economical and r combustion; besides a thick fire is more se a gas explosion, but firing is like every- it must be done to meet conditions.

F. A. M.

Boiler Failures.

dering boiler failures we might dismiss the boiler construction with the assertion that rial and good workmanship will produce a r, were it not for a difference of opinion as to ıds of construction, in which the longitudinal is of the greatest interest. At present the is by general consent conceded a solution of ty.

of the construction of the double stay butt ests a possibility of weakness, in some in- ually as bad as the lap joint. The complete a thickness nearly equal to three times that of ıl plate and is twice the width of a lap joint, perly constructed would be of a curvature ıy other point on the shell.

nbling the sheets, it is the usual practice to se joints above the horizontal center, at a ciding with the supporting lugs. This pro- ırea of stiffness which retaining its original through any change of shape in the shell, ıperature effects or external stresses produces novement of the fibre at this point of the h if repeated often enough would produce a

that engineers' license laws are a factor in ıtion of boiler explosions, would likely be a smile of derision by those who through r ignorance, are blinded to the purpose and ıments of such laws.

ısual observer whose mind is unbiased by pre- not, but admit the great improvement among afforded by a few years experience of license h being a sort of compulsory education law, is of excellent results. Even here in Ohio, where we have an originally weak law poorly enforced, the improvement has been phenomenal.

I do not wish to enter into a discussion of the relative merits of license laws, and especially that of the Ohio law, at this time, but wish to point out the fact that when the engineer is compelled to submit to an examination as to his knowledge of the construction and operation of steam boilers, he at once rises to a higher plane of usefulness.

Ohio now lacks some means of compelling necessary repairs in order to make the engineer work most effectively. This suggests the necessity of a state department of inspection of steam boilers. Engineers should be required to make reports on blanks furnished by the department of the condition of his boiler at each inspection.

A thoroughly enforced law of this kind would, I think, reduce boiler failures to a minimum.

A. J. Wortman.

Gas Engine Troubles.

Many cases of gas engine distress are due solely to a lack of experience on the part of the engineer, or sometimes, to a lack of imagination. It has been said that to become a successful gas engine operator, the first requisite is a vivid imagination, for while running you must sit down and "imagine" that every thing possible and many things seemingly impossible, will happen, for they will happen sooner or later.

Seriously, the gas engine is not as formidable as some engineers would have us believe, nor yet so simple as the manufacturers try to convince us. One case in my experience will illustrate how easy it is to look for trouble when it does not exist.

It was a gas engine electric plant furnishing lights and running only at night. Starting up one evening, everything moved off as usual, until the load was thrown on, then the engine died down gradually and no amount of coaxing or adjusting would bring about the desired impulse for an hour or so. Then it started up all right and ran until the load was again thrown on.

As we had tried every possible adjustment, we "imagined" the valves were set wrong, but on going over them we found them as near perfect as they could be without an indicator. After a strenuous night spent in taking off and putting on valves, cleaning and repointing the igniters, etc., we were no nearer the solution of our problem and our imagination had not suggested anything further. Finally we took off the pipe leading to the gasometers, and there we found the trouble. We use oil in our gasometers and enough had worked into the line to drown out the igniter when the engine was laboring heavily. The hot cylinder walls would finally dry this out gradually permitting a second start, for with no load there was insufficient suction to draw oil up into the cylinders. Simple, wasn't it?

Everything about a gas engine has to be adjusted pretty near right or troubles and grey hairs will multiply.

Igniter.

Convenience of Gas Engines.

Many are strongly prejudiced against gas engines, claiming among other things that they are very hard to start, especially in cold weather; that they will wear out in much less time than a steam engine, and that they will not work when overloaded.

It seems to me that even if we admit these disadvantages, the advantages far overbalance them. Several of these advantages over steam engines, as any engineer knows, are readiness to start without waiting to get up steam in a boiler, less attention required while running and a great saving of fuel.

As to a gas engine being hard to start in cold weather, I can say that I have had but little trouble from that cause, and have operated many.

One gas engine runs a stone crusher, and is set in the open, without shelter of any kind being provided. Many times it has been started without the least trouble when covered, almost hidden, by snow, with the mercury standing near zero. Certainly the shaft and all other moving parts are harder to move when cold than when warm. If the battery, sparker and connections are in good condition, the spark coil dry and the engine and gas in normal condition, no trouble should be found in starting.

The gas engine requires adjusting more frequently than the steam engine, the bearings are more inclined to heat and the packing more liable to blow out. These troubles are caused by faults of construction and are fast being remedied by broader facing and more bearing surface.

For saving fuel the gas engine has no equal. A remarkable instance of this is found in a 40-horsepower engine we use. It was set up a year ago and has been used almost every work day, and during that time has burned but 160,000 cubic feet of natural gas, which, at 8 cents a thousand, the price paid here, amounts to $12.80, or 25 cents a week for 40-horsepower. This is less than half a cent per horsepower a week. This seems like a very extremely low figure, but anyone can look at our meter, which has been tested several times, and see for himself the truth of this statement.

Royal Wolfe.

A Loose Valve Seat.

I had trouble several nights ago with a Climax high speed automatic engine, having a piston type valve and removable seat.

The engine is in the electric light plant which I am in charge of. The seat is tapered and goes into the steam chest from the back end, making a good, tight joint when in position, and is usually held in place by two screws, one in each end. The other night about 30 minutes after starting up for the run the engine commenced to race and the night engineer called me to investigate the trouble. When I arrived at the plant I thought at first it was the governor binding somewhere and as it was not dark I shut down and looked it over, but could find nothing wrong.

After starting the engine again I noticed a thump in the cylinder or steam chest, and by watching the crosshead I noticed that whenever the thump occurred the crosshead was always on the extreme travel. The voltage dropped when the thump occurred, denoting a decrease in speed of the engine.

From this fact and knowing how the seat was held in place it was apparent to me that the seat was loose, which proved to be the case, and when we examined it the next morning we found the screws stripped and the seat loose.

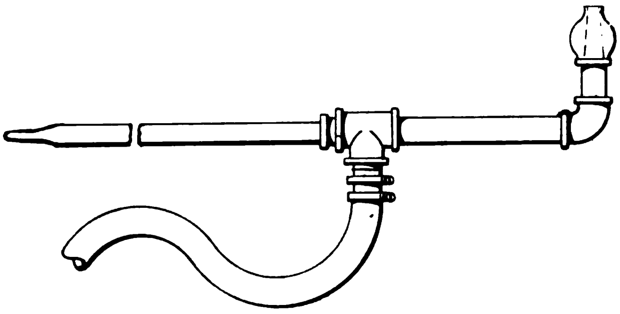
The thump was caused by the seat moving backwards with the valve, thereby closing the head end steam port and partly closing the exhaust port, always occurring when the crosshead was at the crank end of the guide, because the seat could only move back and not forward of the true position, owing to its being tapered. Bud.

Tube Cleaner for Upight Boiler.

During the past several months considerable has been said regarding boilers of different types, but I haven't seen much relating to the upright boiler. Perhaps it is because there are comparatively few of them in use, or perhaps it is because those who have them are so disgusted with them, that when the day's work is done they do not care to discuss them further.

Be that as it may, I have upright boilers in my plant and have decided to tell a few things about them. One of the essential things regarding tubular boilers is keeping the tubes clean, but with the upright boiler it isn't as convenient to do this as with the horizontal return tubular.

The way we do it in our plant is by using a tube cleaner which is made as shown in the illustration. The soot is blown up through the top of the tubes, part of it being taken away by the draft. When it comes to pushing tubes, however, we have a different proposition on hand. On removing the cap a man is obliged to go up on top of the boiler and work with a temperature quite a number of degrees higher than that found on the floor level.



THE TUBE CLEANER.

In some ways I think the upright boiler is preferable, as it requires very little setting and takes up very little space, but it has a very small water space, which is the main objection. Upright boilers are harder to keep clean than return tubular, especially when scale forms badly.

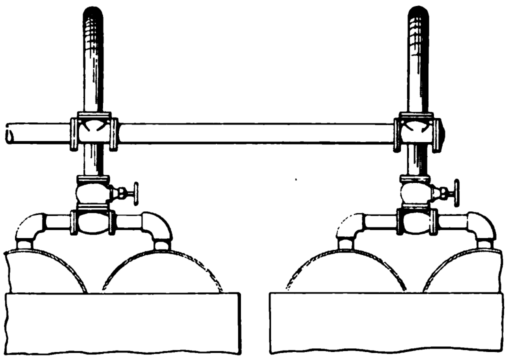
Another feature regarding upright boilers that I do not like, is that the water glass is so high above the fire room floor that it is difficult at times to see the correct water level, owing to the distance from the floor or to a poorly lighted boiler room the latter most generally being the case.

Another thing about them is, that owing to the necessity of climbing a ladder to get to the water column, they are either not shut off when the boiler is out of commission, or during the night, and if they are, there is a liability of forgetting to open the cocks of the water glass when the boiler is fired up again.

I remember an instance of this kind when I went to my first plant of upright boilers. I started up in the morning, while the other engineer shut down at about 11 o'clock at night. The first morning I neglected to blow out my water glass before firing up and had a pretty stiff fire going and steam raised, when I happened to notice that nothing but a few bubbles were coming up from the bottom of the glass. An examination showed that the glass had been shut off when the fires were banked the night before. As it happened no damage was done, as the water was caught before it got too low. It showed me, however, the possibilities that might occur if such little things were neglected. If the water column had been blown out as it should have been, the fact that the glass was shut off would have been revealed to me at the first. W. C. Garman.

Boiler Connections.

A method of connecting boilers to a header which is extensively used is shown in the illustration. Here it will be seen, there are four water tube boilers connected to one header and so arranged that either set of boilers can be cut out at will. This method of piping also allows for a free and easy expansion and contraction of the piping and does away with several objectionable joints.



THE BOILER CONNECTIONS.

If the plant were twice the size and the boilers set face to face it would be a simple matter to connect the opposite battery of boilers in a similar way and connect the two headers by a cross pipe. This is also a method that is carried out in larger plants. In our plant we find the above piping gives good satisfaction, and as yet we have had no trouble with it. D. O. Crawford.

Lubricator Will Not Feed.

I have decided to tell of my troubles and see if any of the readers can help me out. I have a small Detroit lubricator on my engine of the zero type, which positively refuses to feed. I am using an ordinary weight oil which has been strained for use in this particular lubricator. The feed ways are at the top and bottom and are both clear. The valve regulating the feed is opened up sometimes as much as five or six turns and still the lubricator will not feed. The stuffingboxes are all tight and in good condition. Any information from any of your readers in regard to my case will be appreciated. Fred A. Henderson.

Thinks He has a Hard Plant to Fire.

Here goes for the troubles of a stirrup factory engineer. Talk about Bill B. Banger, or any other engineer who ever lived, I will put the factory business against them all. We have a 52-horsepower high speed engine and it is a dandy and easy to keep in shape. For tools I have only a monkey wrench and a club.

We have a 75-horsepower, return tubular boiler. It fires easy, but to tell just how to fire it is a problem. We have from 25 to 30 different machines which require from 2 to 10-horsepower and about 2,000 feet of belting. The heavy machines may all be on and we are firing accordingly, when the men will throw off all the heavy machines and put on the light ones, then away goes our steam up 10 or 15 pounds. By the time we get it down and are firing accordingly, on go the heavy machines again, then down goes our steam and then fighting fire begins in earnest. So we go on, day in and day out, never knowing how to fire. We steam the stirrups with live steam to bend them, and usually when the steam is down the benders will call for more steam and if the engineer don't give it to them, the boss will make his appearance and Sam will have business at the business end of the boiler room.

S. H. Hawkins.

Pump Troubles.

We have in our plant two hot water pumps 6 x 4 x 6-inch to supply our boilers. We use one at a time and run it day and night, including Sundays, the year round, or until it needs repair. Then we take it up and put the other one down and send the one out of order to the shop to be repaired.

The first one we used, after running for a number of years, began to make a sort of a groaning noise and my assistant thought it was in the piston-rod packing. We took the old packing out and put in new, but the noise remained.

This pump takes the water from a feedwater heat at 180 degrees F., the heater taking the exhaust from two paper machines, also from the heating system of the mill and office. It gets cold water supply from a large tank. We used the pump for several months, but it finally got so noisy I took off the bonnet of the water end and found all four of the top valves worn so badly that they could not seat tight on the valve plate. After a machinist had trued them up, we put them back and the noise stopped.

One of the pumps was sent to the repair shop to have some new piston rods put in. When it came back we placed it in the store house, where it stayed for 13 months. When the other one had to be taken out, the one with the new piston-rods was piped up, and steam turned on, it would not start. Thinking the steam valves might be set wrong we took off the bonnet, set them over again and the pump started and run a few strokes when the piston rod on one side turned over, throwing the arm out of the crosshead. An examination showed that the machinist had put the rods in wrong. The right-hand rod was in the left-hand side and *vice versa.* The crosshead of these pumps must be set 1¾ inches different from the other, or the throw will force the arm out of the crosshead.

L. S. Saunders.

More Pump Troubles.

My duplex boiler feed pump made a groaning noise in one of the steam cylinders recently and upon examining it I found one side had plenty of cylinder oil, while the other was dry. I started the pump up again and let the lubricator work as fast as it possibly could, but still the piston made the noise, and upon examining the cylinder again, I found it as dry as ever.

I next mixed some cylinder oil with graphite and put that into the cylinder and started up again, and did not hear the noise for some time, but the next day the same trouble made its appearance. In thinking the matter over I decided that the lubricator must be too small, so I put a larger one on the pump, which was of the sight feed type, and I have not heard the noise since.

UESTIONS OF THE HOUR

his department questions concerning steam engineering of a prac-
ature and of general interest will be answered.
name and address of the writer must accompany questions, but
essarily for publication. We must know the source of the question.

---

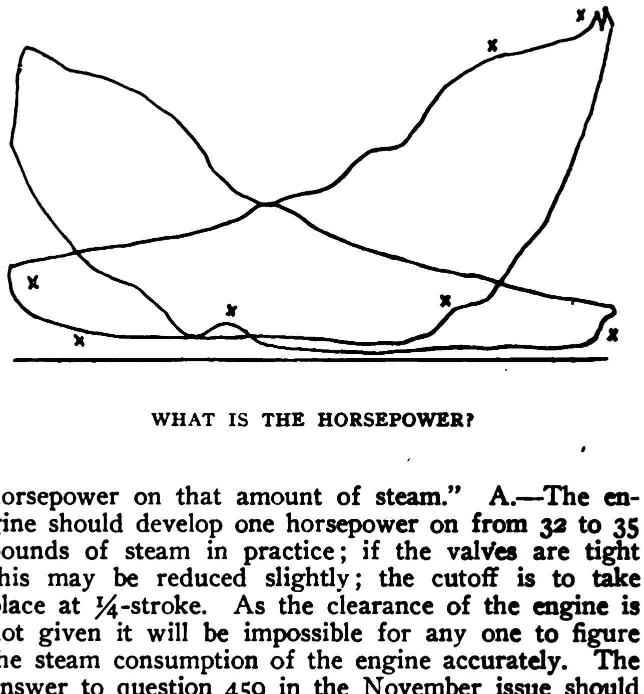
70) G. B. W., Indianapolis, Ind. Q.—"Could my
s be operated by connecting the discharge pipe of
o the suction of the other and double the distance
ump would force the water, the pipes to be run
one pump to the other in a horizontal position?"
Yes. But if the piston speed of one pump were in-
ed, also the steam pressure, the same result would
tained as if both pumps were operated at the ori-
speed and with 50 pounds steam pressure.

71) G. H. M., Newburyport, Mass. Q.—"In
ronizing two alternating dynamos, is it better to
the pilot lamps when they go out, or by the hand
e indicator? Is the hand supposed to stop? When
running the hand goes around the dial so fast
it is difficult to catch it." A.—The practice used
to watch the lamps and when they became dead,
row the machines together. The latest practice,
ver, is to be guided by the hand on the synchroniz-
ndicator and when it becomes stationary, show-
at both machines are operating at the same speed,
should be thrown together. If the hand revolves
d the dial of the indicator at a rapid rate it in-
s that the machine to be thrown in is running
st and therefore should be slowed down until the
tor is stationary over the point which indicates
both machines are running at the same speed,
they are to be thrown together. If the hand
ehind the indicating point, it shows that the ma-
is running slower than the one already carry-
e load and should, therefore, be speeded up. If
gines are not equipped with a regulating device
eed of the engine will have to be changed by
ling, which is not a very satisfactory method.

2) V. J. P., Denver, Colo. Q.—"I have an air
essor running at a speed of 65 strokes per min-
The size of the cylinders is 16 x 24-inch. The
essor discharges into a receiver having a pres-
f 90 pounds. What is the horsepower of the
essor and how many cubic feet of air will it
per minute?" A.—As your question is rather
itely stated we are left to assume considerable as
at you want. We are assuming that the compres-
belt driven and that you wish to know the piston
cement per minute in cubic feet and how many
ower it will require to compress air at a work-
essure of 90 pounds per square inch. At a speed
½ revolutions or 65 strokes per minute, the pis-
isplacement will be 16 × 16 × .7854 × 24
÷ 1,728 = 181.5 the displacement of one cyl-
in cubic feet. If the machine is a duplex com-
r the displacement will be 181.5 × 2 = 363
feet. This will require about 70 horsepower.

3) E. P. C., Chimo, Cal. Q.—"If I have a
with a steam cylinder 5 inches and water cyl-
8 inches in diameter having a stroke of 8 inches,
nuch water pressure could I get with a steam
re of 85 pounds?" A.—The size cylinders as
above will not be found on pumps designed to
water against a pressure, but are found on con-
s where the water is discharged against atmos-
pressure only. As to the pressure that may be
d under the conditions as stated above, it will depend upon the length of the discharge pipe, the size and the friction due to bends, slippage of water past the piston packing, etc. With the best of conditions, both in the water and steam end, the pressure could not be greater than the steam pressure, and would of course be less as the pressure of the steam began to drop as the piston was forced from one end of the cylinder toward the other. Supposing that there were a mean effective pressure in the steam cylinder, which there will not be, of 85 pounds, there would be a loss in the pressure available for direct work in forcing water equal to the amount expended in overcoming the fricton of the pump itself and condensation. Just what this would be, depends upon the construction of the pump and the condition the engineer has kept it in. The water pressure could not be greater than the mean effective pressure of the steam in the steam cylinder.

(474) N. W. J., St. Louis, Mo. Q.—"I would like to have some of the readers of the Review figure out the steam consumption of the accompanying indicator card and explain why the steam line drops so fast. The engine is of the four-port type, size of cylinder 14 x 15 inches, running at 250 revolutions per minute with 120 pounds of steam. I have figured the card and obtained 26 pounds steam consumption per horsepower and I do not think the engine will develop a horsepower on that amount of steam." A.—The engine should develop one horsepower on from 32 to 35 pounds of steam in practice; if the valves are tight this may be reduced slightly; the cutoff is to take place at ¼-stroke. As the clearance of the engine is not given it will be impossible for any one to figure the steam consumption of the engine accurately. The answer to question 459 in the November issue should give enough data to enable you to figure the steam consumption without trouble.



WHAT IS THE HORSEPOWER?

(475) E. A. B., Kendallville, Ind. Q.—"Will someone kindly give me the name of a good covering for the cemented floor of an engine room? Shellac renders cement impervious to grease, but not to water, and I wish a covering that will be proof against both. I would also like the opinion of the readers regarding the use of ground mica as a lubricant."

The best designed boilers, well set, with good draft, and skillful firing, will evaporate from 7 to 10 pounds of water per pound of first class coal.

To find the surface of a ball multiply the square of the diameter by 3.1416.

Engineers' Review

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simpler than that used with the direct current n. That is one of its advantages. Less substa- are required for any stated distance than with the current system, and the expense for attendants ninated.

perfecting this system not only has it been neces- to design a motor which shall fill the require- , but controlling apparatus has had to be devised ndle the alternating current so that it can be suc- lly handled by the operator of the car.

other proposition arose, that of designing ap- us suitable to operate with an alternating single- current while the car is running on this system, apable of being operated interchangeably with direct current, while running within the city , or with alternating current in the country. This nvolved the designing of trolley apparatus suit- or either condition.

of this has been accomplished. The high voltage r construction has been developed and so thor- y strong and practicable has it proven that 3,300 have been found safe and reliable.

course difficulties have been met, but the trou- ave not been fundamental and inherent in the -phase system. The successful operation of sev- ong distance trolley lines with the single-phase n and the equipment of a large number of others being installed lends support to the assumption it no distant time the greater number of inter- trolley lines will be operating with the single- alternating system.

: adoption of the alternating current system for iburban lines running into New York city by the York and New Haven railway company has d an important advance in electrical railway de- nent. After a thorough investigation of conditions n view of present tendencies, a commission of en- 's decided, on behalf of this company, that the ating system promised best for its particular condi- This application of the electrical current railway is one which will thoroughly test the capabilities : system. A peculiar condition exists, the New New Haven and Hartford railway company en- New York city over the tracks of the New York il and Hudson river railroad, which company has d the direct current system, reaching some 30 out from its terminus; therefore, the selection of rent system by the New Haven road shows the ad- that has been made in supplying power to electric y cars during the last three years. There is no that either system will perform the work for it is intended, satisfactorily.

SUPERHEATED STEAM.

BY C. H. BENJAMIN.

has been before suggested in these columns, the f superheated steam is today one of the most sing methods of reducing cylinder condensation hould receive due consideration at the hands of large user of steam power. Like all economics its drawbacks, its advantages and disadvantages ese must be understood and appreciated if one is ure on a probable saving. Now, superheated does not always mean hotter steam, it simply steam which has been separated from the water eated to a temperature higher than that due to ssure.

To illustrate: Steam in contact with the water, or saturated steam as it is usually called, has always a definite temperature corresponding to its pressure. We will suppose that such steam has a pressure of 150 pounds gage, then its temperature will be about 365 degrees F.

Now let us suppose that another mass of steam has a pressure of 50 pounds gage, its temperature will be 297 degrees F. Suppose, further, that this second steam was taken from the boiler and heated in a superheater 50 degrees to 347 degrees F. The second steam will not be as hot as the first, but it is superheated and will not condense on the walls of the engine cylinder until it has cooled down to 297 degrees F.

The first steam is saturated and will condense immediately on striking the cylinder walls. For a simple engine the second steam might be more economical than the first, although at a much lower pressure.

Superheat costs coal and money just the same as other forms of heat. The superheater is an additional expense for first cost and for repairs. When located in the smoke chamber back of the flues it simply takes heat that might have gone into the boiler steam and does not necessarily save or utilize waste heat.

Steam at 150 pounds gage has a temperature of 365 degrees F. and the chimney flue does not need to be much hotter than this for good draft. If we wish to superheat this steam 100 degrees we must have a hotter smoke chamber or perhaps put our superheater back nearer the fire. In either case we are not saving heat but merely using it in another way. Consequently if superheated steam possessed no other advantages over saturated than the mere fact of being hotter it would hardly pay to bother with it.

If we have an engine using steam at 100 pounds gage pressure and expanding it down to the pressure of the atmosphere the highest possible efficiency with no initial condensation is 14.7 per cent, that being the ratio of the work done to the heat received. Adding 100 degrees superheat to the steam will only raise the average efficiency to 15.1 per cent; not enough to pay for the trouble.

As a matter of fact the efficiency of the engine just mentioned without superheat will be much less than 14.7 per cent on account of condensation in the cylinder, probably running as low as 11 or 12 per cent. Now 100 degrees of superheat will prevent the most of this condensation and bring the actual efficiency up to perhaps 14 per cent in this way.

Statements as to the actual saving effected by superheating are very contradictory, but there is little doubt that they amount in many cases to 10 or 15 per cent. In compound engines there need be only enough superheat to insure dry steam at cutoff in the high pressure cylinder. Any additional heat should be supplied at the receiver by live steam coils or otherwise. As against the advantages enumerated must be offset some disadvantages. The superheater adds to the first cost of the boiler and increases the annual expense account. Gaskets, packing, valve seats, etc., give more trouble when high temperatures are used and are more expensive. Piston-rod and valve stem packings will cost more and a higher grade of oil must be used. If slide valves or piston valves are in use it will be more work to keep them in repair. In short, the whole steam plant should be designed with reference to the use of high temperatures, since putting superheated steam into an old plant will be as disastrous as putting "new wine in old bottles."

THE MORGAN ENGINEERING CO.'S BLOWING ENGINES.

The Morgan Engineering Co. have recently installed four large blowing engines; three at the Adrian furnace of the Rochester & Pittsburg Coal & Iron Co. at DuBois, Pa., and the fourth at the plant of the South Chicago Furnace Co., South Chicago, Ill. All four of these engines were designed and built by the above named company. One of the blowing engines is shown in Fig. 1.

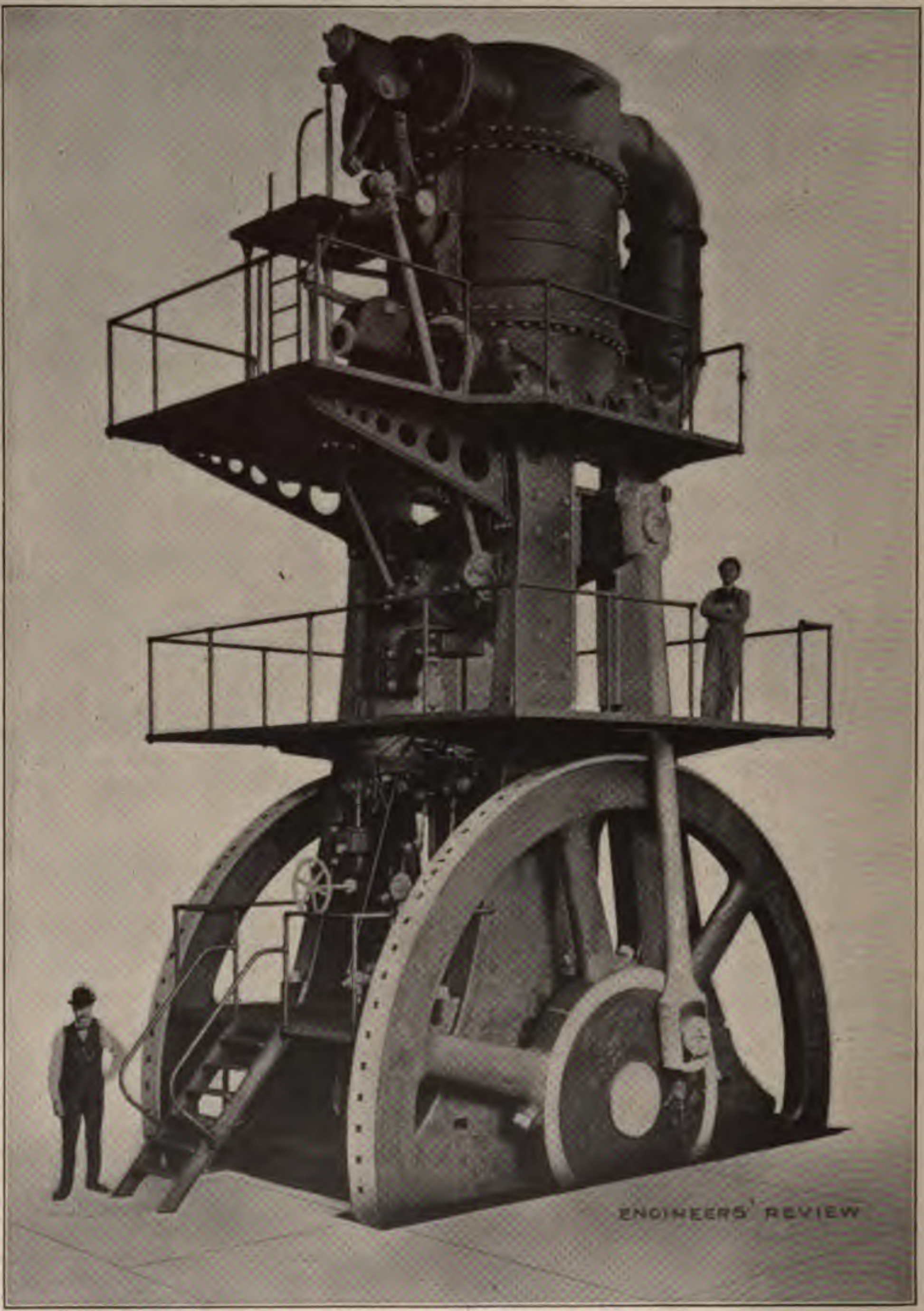


FIG. 1. ONE OF THE MORGAN BLOWING ENGINES.

The engines are of the vertical long crosshead type, simple noncondensing and have the steam cylinders below the crosshead and the air cylinders above. The diameter of the steam cylinders of these engines is 44 inches, while the air cylinders are 84 inches in di
The stroke of the engines is 60 inches. Thu
revolutions per minute each machine will delive
16,000 cubic feet of free air per minute, at 25
above atmospheric pressure. These engines we
structed under the most rigid specifications as t
manship and material, and at the present time a
ing the best of satisfaction.

The main bedplate rests directly upon the fou
tion and is cast in one piece. This bedplate is of
sive form, strongly ribbed and in every way suit
for rigidly supporting a heavy machine like these
gines. The bedplate is cored to receive a thick laye
babbitt metal which forms the bearings of the flyw
shaft. These bearings are very carefully bored to

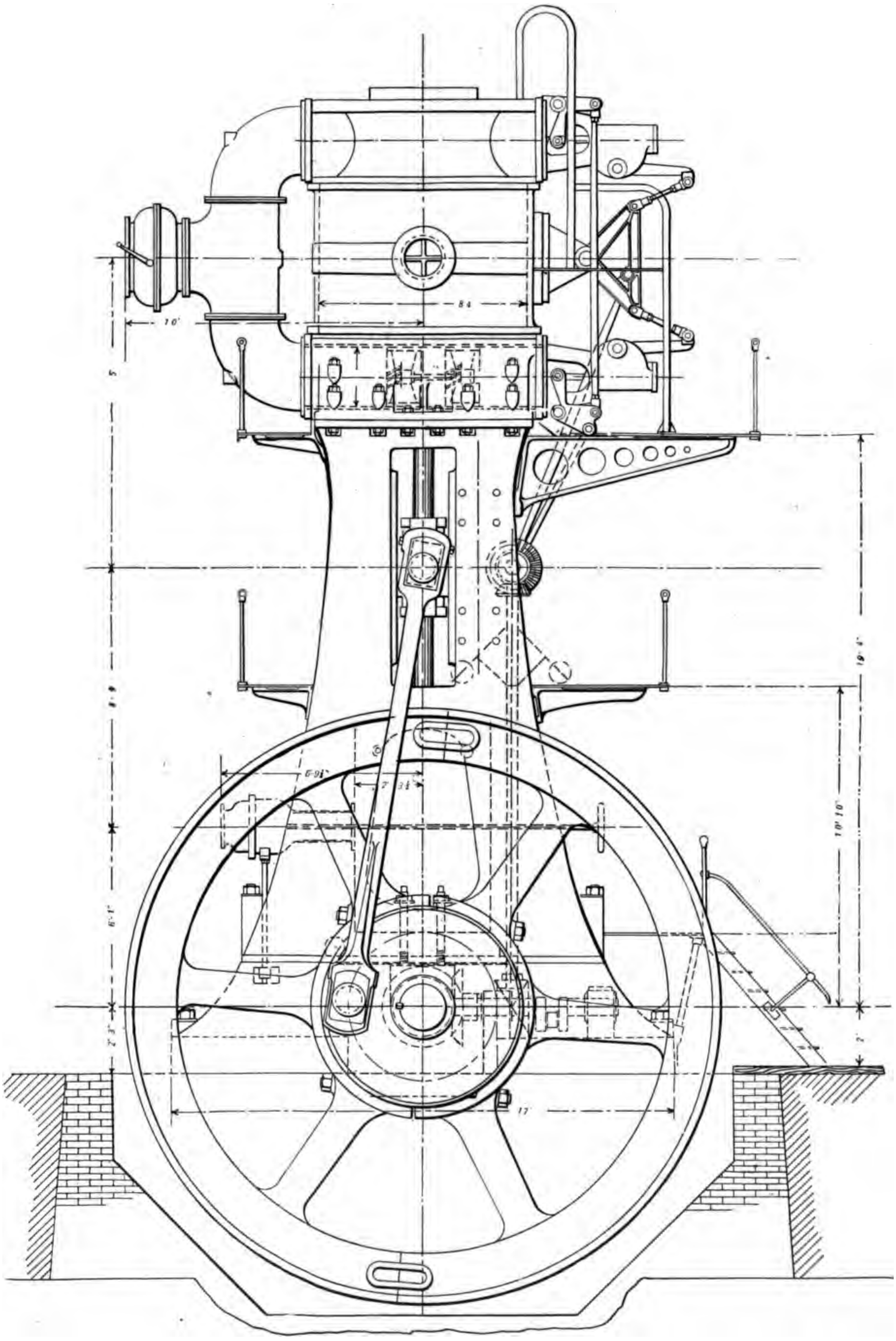


FIG. 2. CROSS SECTION OF BLOWING ENGINE.

scraped and provided with ample means for lubricati The caps for the main bearings are strongly made a held in place by four 3-inch tap bolts.

The flywheels, of which there are two to each e gine, are 2-feet in diameter, each weighing about 5 000 pounds. They are well counterbalanced and c culated to run at a speed much in excess of that to whi they are subject under the hardest service. The cent hub of each flywheel is of cast iron and strongly keyed the shaft. These hubs form crank disks into which t crankpins are forced and riveted. The rim on the whe is made in halves and securely fitted to the disk. In t rim it will be noticed are recesses to allow for barri the wheel.

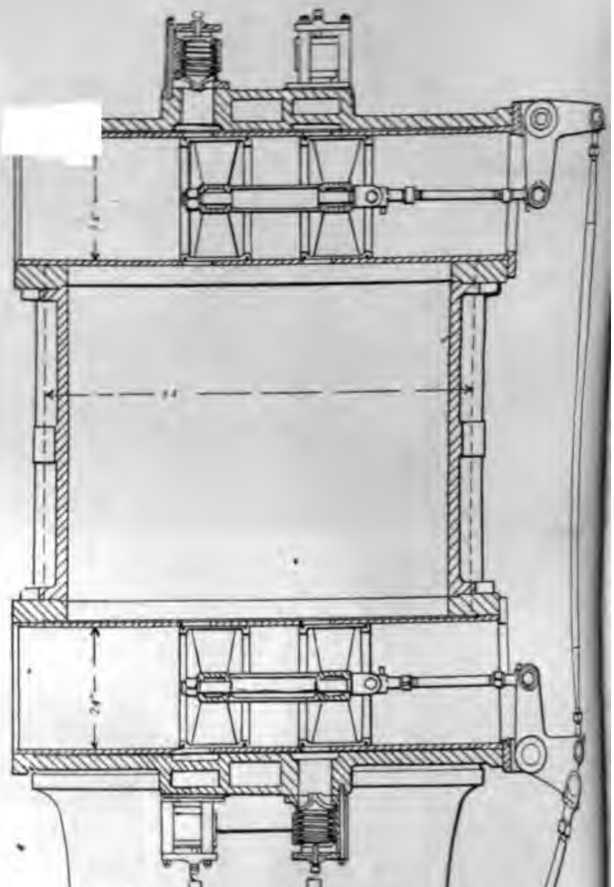


FIG. 4. SECTION THROUGH AIR VALVES.

The crankpins, which are 10 inches in diameter, ar made of the best grade of steel forgings of about per cent carbon, and as stated above are forced into the crank disks and riveted thereto.

The main shaft is 20 inches in diameter. It is als of the best quality of forged steel and is ground true on dead centers.

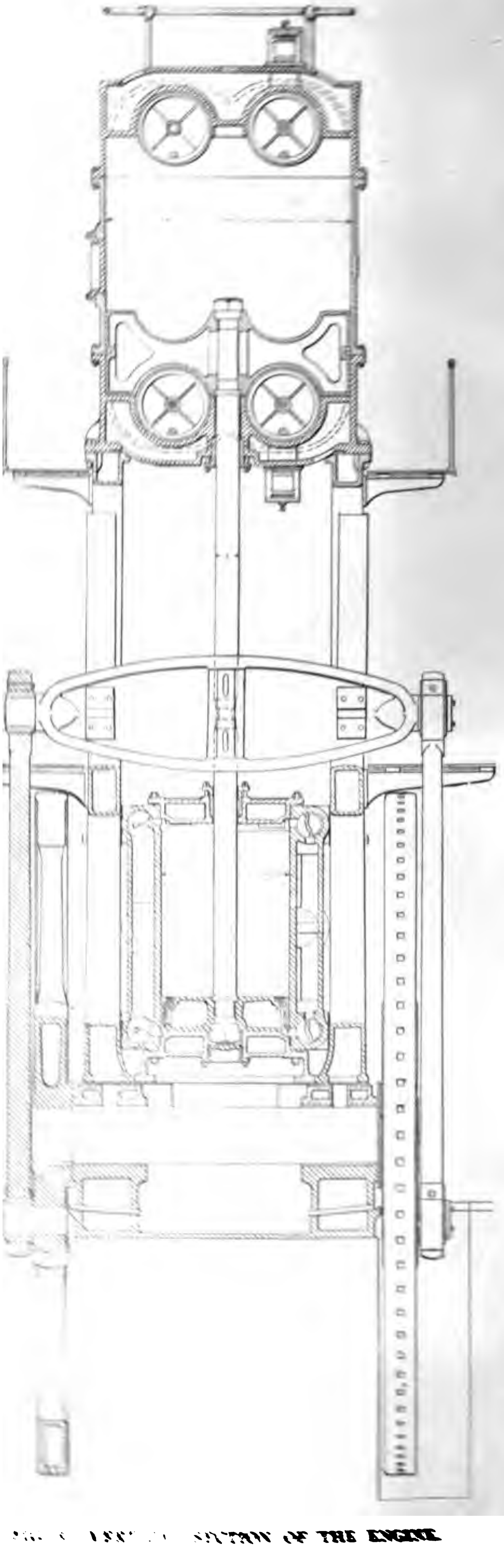
The connecting-rods, of which there are two to each engine, are of open hearth forged steel of from 25 to 30 per cent carbon.

type, provided with t

lining, adjusting wedg

in the bearing.

The steam



[illegible] SECTION OF THE ENGINE

cast iron

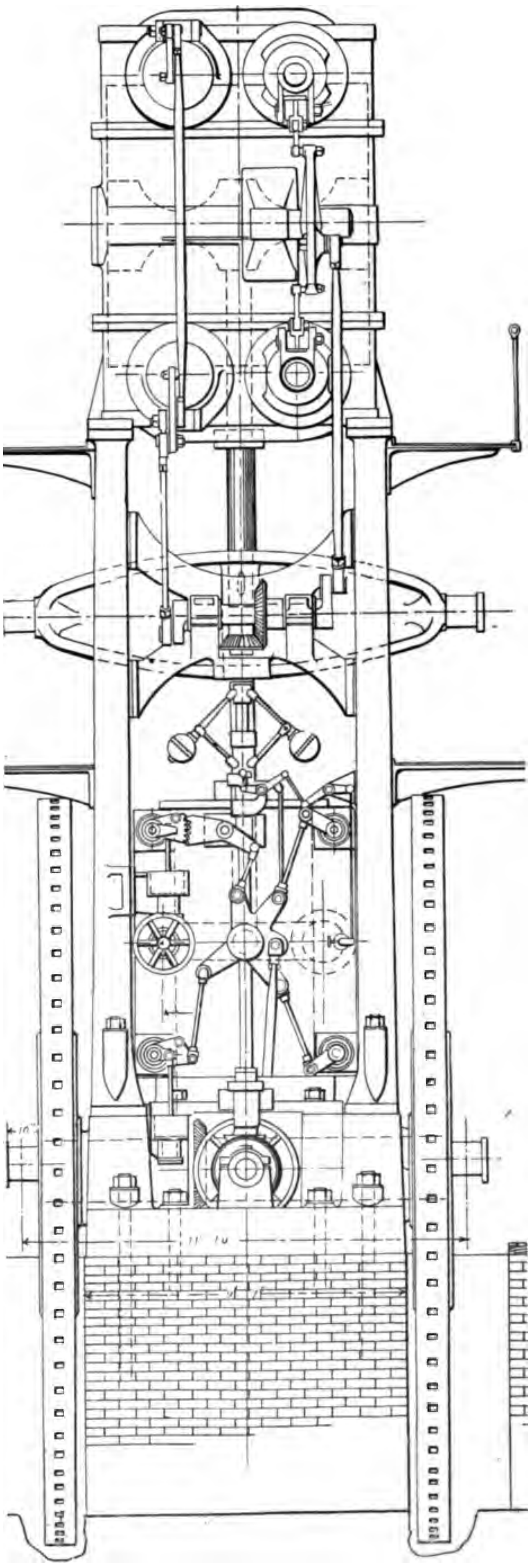


FIG. 5. DIAGRAM SHOWING THE VALVE GEAR.

for the valves which are of the Corliss type. The exhaust chamber is cast separate from the cylinders, thus reducing internal condensation. The steam cylinders are lagged with nonconducting covering and furnished with sheet steel jacket with corner angles. A relief valve is located in each end of each cylinder.

The crosshead is a steel casting carefully annealed and ends turned to form the crosshead pins. The shoes of the crosshead are of cast iron, faced with babbitt metal.

Each engine has two side housings or frames, which, as will be noted from the illustrations, extend up and form the support for the air cylinder. These housings are rigidly constructed and stiffened by cast iron cross braces.

As is the case with the steam cylinder, the air cylinders are also composed of specially selected cast iron stock, having as close a grain as is consistent with good machinery. Fig 2 shows a cross section of the blowing engine, Fig. 3 a vertical section.

The air valves are of patent horizontal piston type, both inlet and outlet valves being double ported and 24 inches in diameter. The inlet valve, shown in Fig. 4, has a simple harmonic action, but the outlet valve mechanism shown in Fig. 6 is so arranged as to give quick opening at the instant of delivery and insure a long pause on the return stroke. The whole system receives its motion from the lay shaft and gearing from the main shaft of the engine. Great care has been used in designing these valves and connections that they might be sufficiently strong and yet not contain weight detrimental to their proper operation.

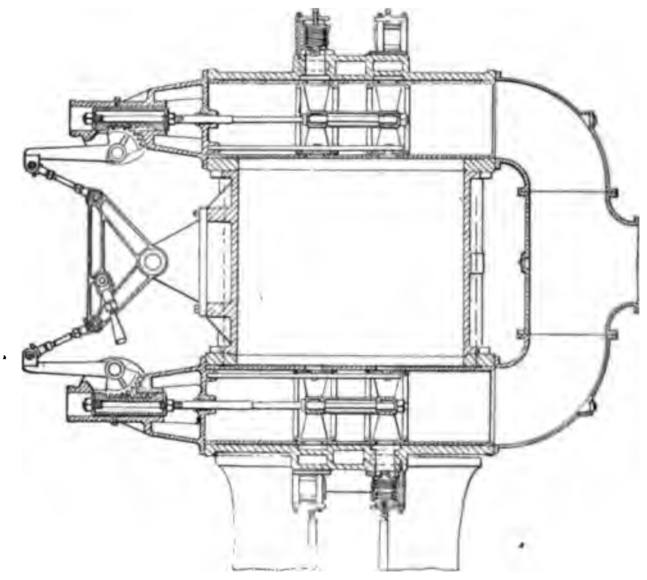


FIG. 6. SECTION THROUGH AIR DISCHARGE VALVES.

As stated, the steam cylinders are fitted with standard Corliss type valve gearing, operated through a single eccentric and wristplate. The valve gear is shown in Fig. 5. The governor is of the ball type driven positively by gearing, with speeding device to govern the engine through a considerable range without stopping it.

The total weight of each of the engines described is about 400,000 pounds.

INDICATOR PRACTICE.

COMPUTATION OF WATER CONSUMPTION FROM DIAGRAM —THEORETICAL CURVE.

BY W. H. VINCENT.

In the foregoing articles we have seen how the mean effective pressure and horsepower can be determined from the indicator diagram. It is frequently necessary to make computations of either the amount of steam used per horsepower, or the amount of water per horsepower accounted for by the diagram. In order to compute the water consumption of an engine from a diagram, it is necessary to know the clearance which is usually taken as the space included between the piston and the valves when the piston is at the end of its stroke, and space between the piston and the cylinder head and space taken up by the ports.

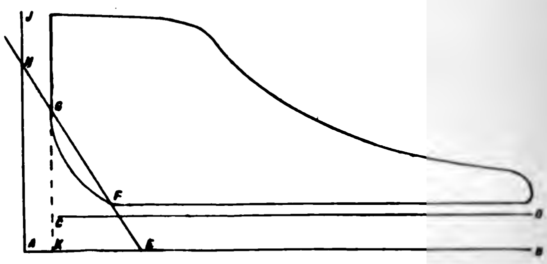


FIG. 1. METHOD OF DETERMINING THE CLEARANCE.

This is usually expressed by a percentage of the total volume of the cylinder, and is quite often known for different makes and types of engines. If it is not known, the position of the clearance line may be found in the following manner from a diagram as shown in Fig. 1. First draw the vacuum line *A B*, at a distance to represent 14.7 pounds below the atmospheric line, *C, D*. Then draw a straight line *E, F, G, H*, across the compression curve. Then measuring from *E*, the distance *G* to *H* should be equal to the distance *E* to *F*. The line *A J* is then drawn through *H*, perpendicular to *A B*. The length of the line *A K*, divided by *K B*, will give the percentage of clearance.

An indicator diagram will show by direct measurement the pressure and volume at any point in the stroke of the piston. The weight per cubic foot of any given pressure may be taken from a steam table direct. The method of computing the weight of steam for any point in the stroke, is to find the volume in cubic feet, which includes the clearance and piston displacement to the given point which must be taken at cutoff or later. The volume in cubic feet multiplied by the weight per cubic foot corresponding to the pressure at the given point measured on the diagram will give the weight of steam in the cylinder. This must be corrected, however, as this weight includes steam used for compression, the result being the weight of steam used per stroke.

In order to make the correction the following method is pursued. Select some point on the compression curve as at *K*, Fig. 2, and measure its absolute pressure at this point. This weight subtracted from the weight of steam at the point taken in the expansion curve, already computed, will give the result in weight of steam used per stroke. The best point on the expansion curve is just before release takes place, because the maximum amount *of leakage has occurred* if it is to take place at all, and a certain part of the steam which is condensed during admission and the first part of the stroke is reevaporated into steam, and so does useful work toward the latter part of the stroke.

The actual computation of the steam consumption from an indicator diagram may well be illustrated by working a practical example. Assuming that Fig. 2, represents a diagram from an engine having a mean effective pressure of 40 pounds, running at a speed of 80 revolutions per minute and a cylinder 20 by 36 inches, it figures out 166 horsepower. In Fig. 2 *L M*, is the atmospheric line, and *N O*, is the line of absolute pressure drawn so that *L P*, equals 14.7 pounds to say a 40 scale. *N P*, is the clearance volume which equals say, 8 per cent of the piston displacement. The line *R K* is drawn from the line *N O*, to some point on the compression line, and from *S*, a point on the expasion line just before release, the line *S T*, is drawn perpendicular to *N O*. Then measuring from the diagram we have *N O*, = 3.24 inches; *N T*, = 3.06; *N R*, = .40; *S T*, = .70; *K R*, = .70. The length of the stroke is 36 inches and the length of the diagram is 3 inches. Then 1 inch in length of the card represents 1 foot of the stroke. The scale used is 40, therefore we can reduce the above dimensions to pounds pressure and to feet which gives the following results. *N O* = 3.24 × 1 = 3.24 feet; *N T* = 3.06 × 1 = 3.06 feet; *N R* = .40 × 1 = .40 feet; *S T* = .70 × 40 = 28 pounds, and *K R* = .70 × 40 = 28 pounds.

The diameter of the piston is 20 inches, which equals 314 square inches, or 314 ÷ 144 = 2.18 square feet. When the piston is at *S*, the volume is 2.18 × 3 = 6.54 cubic feet. When the piston is at *K*, the volume is 2.18 × .40 = .872 cubic feet. From the steam tables we find the weight of a cubic foot of steam to be at 36 pounds pressure, absolute, .088069. The weight of steam present when the piston is at *S*, is 6.54 × .088069 =.5759 pounds. The weight of steam present when the piston is at *K*, is .872 × .088069 = .0768 pounds. The weight of steam in the cylinder at the point of release is .5759, and the weight kept in at exhaust closure for compression is .0768 pounds. The weight of steam exhausted for each stroke is, therefore .5759 — .0768 = .4991 pounds. This quantity multiplied by the number of strokes per hour, will give the weight of steam to be accounted for by the diagram, which subtracted from the actual weight of feedwater used during this time will give the cylinder waste due to condensation and leakage.

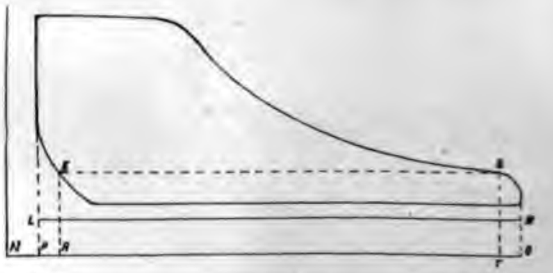


FIG. 2. METHOD OF DETERMINING THE STEAM CONSUMPTION.

Owing to cylinder c
the indicator diagram d
used in the cyli
class of engin
cutoff, unde

able difference between the actual consumption and that represented by the steam accounted for, except in engines using steam which is highly superheated. In engines which are tight, of the single cylinder class and running under ordinary conditions the difference varies from 15 to 50 per cent, according as to the cutoff, whether it is long or short. This difference is usually due to cylinder condensation.

Frequently the character of the expansion line will give information regarding the action of the steam in the cylinder. In order to know how the expansion line is holding up to the standard, it is necessary to have a standard curve with which it may be compared. This curve is known as the equilateral hyperbola, but too much dependance should not be placed upon an agreement or disagreement with the hyperbola, because it is not the theoretical curve of steam, and there is no reason theoretically, why the expansion lines of a diagram should be an hyperbola. The theoretical expansion line is that which the steam pressure would follow if it varied inversely as the volume.

If it were possible to operate an engine in which a perfect gas were expanding under such conditions that the temperature would remain the same at all points in the stroke and if a card were taken, the line traced would be a hyperbola, and the gas would follow the law of Marriott, which is as follows: The temperature remaining the same, the volume of a given quantity of gas varies inversely as the pressure.

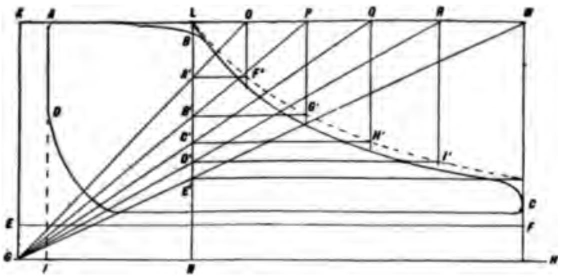


FIG. 3. METHOD OF DETERMINING THE HYPERBOLIC CURVE.

This law does not apply to steam, however, and the true expansion line for steam at constant temperature is a straight horizontal line. It is the line shown from the point of admission to the point of cutoff, or what is commonly known as the steam line, the expansion taking place in the boiler and steam pipes, and the condensation supplied by enough steam to make up for that which was lost. When the steam valve closes the expansion at constant pressure stops and the steam begins to expand by virtue of its own heat. As there is no chance for heat, or steam to be supplied from the boiler, the temperature drops as well as the pressure, and a portion of the steam condenses. As the piston proceeds toward the end of the cylinder the pressure becomes so low that the temperature of the expanding steam is less than that of the cylinder walls, when part of the water will evaporate into steam again. The expansion line is a record of the total actions of what takes place in the cylinder during the stroke, but the form of the expansion line depends upon many things.

The point of cutoff, whether late or early, is largely due to the amount of condensation, and the expansion line is affected by this. The difference in the amount of clearance has also considerable to do with the shape of the curve. In fact it cannot be stated positively what shape the curve will take, as so many conditions enter into the matter.

The main purpose of the hyperbolic curve is that of assisting in detecting leaks in an engine, but as already said, too much dependence must not be placed upon it.

The construction of the theoretical curve is not as difficult as many suppose, from merely glancing at a diagram of one. A simple method of drawing one is shown in Fig. 3, the indicator diagram being shown by the lines *A*, *B*, *C* and *D*. The atmospheric line is *E F*. First draw the vacuum line *G H*, 14.7 pounds, to scale as already explained, and on this, project the two ends of the diagram *A I*, and *M F*, making the distance between them the length of the diagram. Next lay off *G I*, to represent the clearance as has already been explained, and then draw the vertical line *G K*. Then prolong the steam lines *A L*, to *M*. Then locate the point of cutoff *B*, and project it vertically to *L*, and draw the vertical line *L N*.

Next draw at random from the point *G*, the lines *G O*, *G P*, *G Q*, *G R*, and *G M*, cutting the lines *L N*, and *A M*, respectively as shown at *A'*, *B'*, *C'*, *D'*, *E'*, and *O*, *P*, *Q*, *R*. Through the point *O* and the point *A'*, draw perpendicular lines intersecting at *F'*, which will be a point on the required expansion line. In a similar manner the points *G'*, *H'*, and *I'*, are found and the expansion line drawn through them, as shown by the dotted line. This line represents a perfect expansion line and shows what the engine should have done with the amount of steam and the rate of expansion as applied to any individual circumstance. If the curve given by the indicator should be above the theoretical curve it is taken as an evidence that the steam valves leak. When the curve made by the indicator is below the theoretical curve, it is a sure indication that the exhaust valves or the piston leaks.

STEAM TURBINES FOR SEA SERVICE.

The pioneer turbine steamer was the Turbinia built, and the trial trip run in the year 1894. The first attempt to operate the steam turbine in marine practice was by means of a single compound engine of rather radical type coupled to one shaft having a two-blade propeller, 30 inches in diameter, but with discouraging results. Next propellers of four blades were tried, but without the desired effect. The next move was to multiply the propellers and set them about three diameters apart on the shaft, the result being that a speed of 19¾ knots was obtained. From that time up to the present the use of steam turbines as a means of steamship propulsion has gradually increased until at the present time numerous steamships of various designs are either operating with steam turbines or are in the course of construction.

Another steamer equipped with steam turbines is the steamer Manxman, recently built. This steamer has three sets of expansion turbines. The center shaft is driven by the high pressure turbine, and the two side shafts are driven by the low pressure turbines. The astern driving turbines are mounted on the side shafts, and take steam direct from the boilers.

Fig. 1 is a view of the turbine room looking from the starboard side of the ship, and showing all three turbines, the one in the center being the high pressure turbine; the apparatus on the end being the governing mechanism. The governors are mounted on each shaft, but only become operative in the event of a break down, or of excessive racing of the propellor shaft.

The centrifugal governor generally adopted in the Parsons turbine, operates by moving a small relay plunger which regulates the steam admission to a relay, which in turn actuates the main throttle valve, which is generally of the balanced double-beat type. The exhaust from the steam relay is utilized for the steam packing of the steam gland. The governor, therefore, has very little work to do, having only to move the small plunger, and is consequently very sensitive. The governor is made still more sensitive by keeping the whole governor gear in slight movement by connecting one of the pivots to the lever with a cam. These movements are so rapid as not to affect the even turning moment of the turbine.

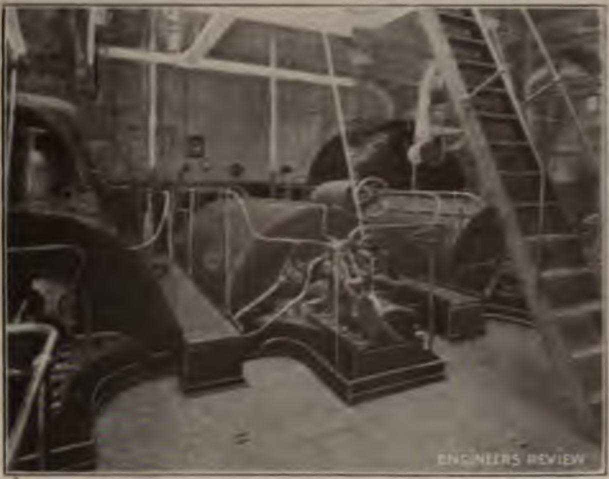


FIG. 1. VIEW OF ALL THREE TURBINES FROM THE STARBOARD SIDE.

A bypass valve is located on top of the high pressure turbine, to be used for the admission of steam at full pressure to an intermediate stage of the high pressure turbine, so as to increase the power. This is done, however, at the expense of economy.

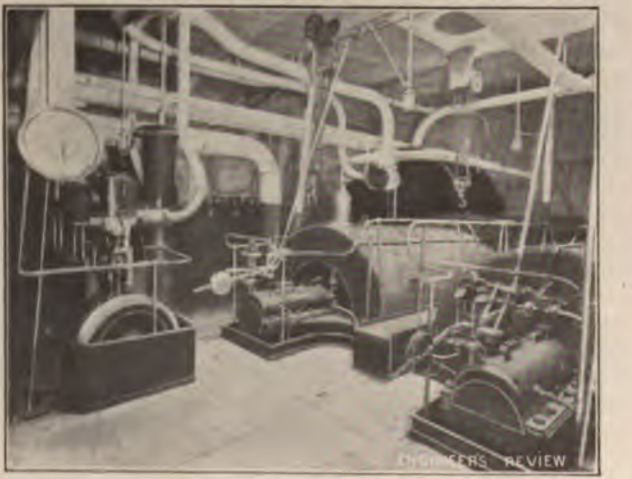


FIG. 2. VIEW OF STARBOARD SIDE OF TURBINE.

In Fig. 2, the center or high pressure turbine is shown at the right, the starboard low pressure turbine being in the center of the illustration. The air pump is shown at the left under the engine telegraph signal system and behind it is located the circulating pump, both of which are driven from the shaft of the same engine.

The low pressure turbines are each connected to a condenser, the starboard condenser showing up in the background as a dark mass. The low pressure turbine is supplied with steam by means of the large pipe in the foreground for maneuvering purposes. Through this pipe full steam pressure may be supplied to the go-ahead turbines and if so desired all three turbines may be operated at high pressure. Above this pipe is a steam lead to the go-astern turbine, which is mounted on the side shaft abaft the low pressure go-ahead turbine.

During the trial trip the Manxman attained a speed of a little over 23 knots, with a boiler pressure of 192 pounds. The steam in the high pressure turbine was 180 pounds and in the low pressure turbines a pressure of 20 pounds was carried. The vacuum in the port condenser was 28.25 inches and in the starboard 28.4 inches. The high pressure turbines revolved at a speed of 533 turns a minute, while the low pressure turbines ran at a speed of 609 revolutions a minute. The result of the official six hours trial was a trifle below the above figures although equally striking. The mean speed was 22.65 knots per hour. Revolutions of the high pressure turbine were 520, and the revolutions of the low pressure turbines 590 per minute. The port vacuum was 28.6 inches and the starboard vacuum 28.4 inches. The high vacuum maintained was a notable feature and was frequently as high as 29 inches.

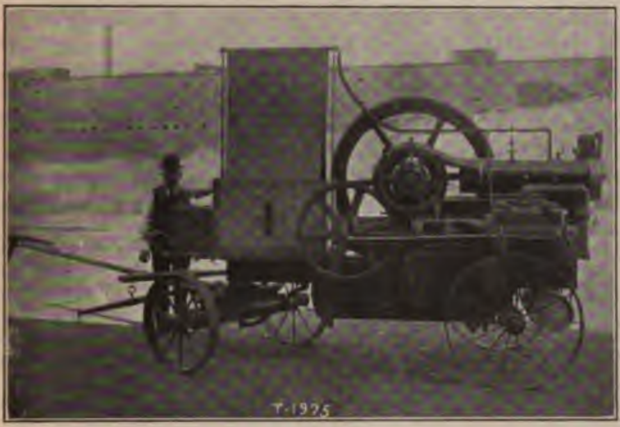
PORTABLE AIR COMPRESSORS FOR THE PANAMA CANAL.

The Panama Canal Commission recently placed an order with the Rand Drill Co., of New York, for two portable air compressors which embody some features of distinct novelty. These machines are intended to operate pneumatic tools in general repair work in the canal service. It is also expected that they will be found of great assistance in erecting the heavy machinery which of necessity will be delivered in sections along the line of work.

The illustration gives a good idea of the arrangement of these compact little plants. The prime mover is a 16-horsepower gasoline engine. It is mounted on two steel channels which constitute the frame of the truck. The engine shaft has at one end a heavy flywheel 4 feet 8 inches in diameter; at the other end is a driving gear fitted with a friction clutch. Below and at one side of the engine, a small Rand single stage air compressor is mounted, fitted with the usual mechanical intake and automatic discharge air valves, familiar to all acquainted with the machines of this manufacturer. The crank gear of the compressor meshes directly with the driving gear of the engine and a valve-rod operates the air valve gear by means of a back crank. The engine is, of course, started unloaded, with the friction clutch free. When full speed is attained, the clutch is thrown in and the load on the air compressor assumed. Gearing is such as to give the compressor a speed of 150 revolutions per minute, at which the displacement of the compressing cylinder is 60 cubic feet of free air per minute, which is delivered at a pressure of 100 pounds.

A novel feature of this equipment is the method of cooling the circulating water for the engine and compressor cylinders. While provision is made for connection with an outside source of water wherever available, it has also been arranged for the machine to carry its own water supply. A rectangular open tank holding about 100 gallons of water is mounted on the truck in front of the engine. A small pump driven from the engine shaft draws water from this tank and circulates it through the cylinders of the engine and compressor.

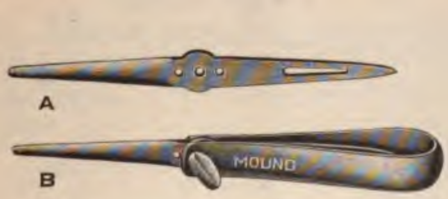
This water, heated by contact with the cylinder walls, flows upward to a perforated pipe elevated above the supply tank. It is here discharged through a series of fine holes and flows downward over a sheet of burlap to the tank below, being cooled by evaporation being exposure in a thin sheet to the open air.. An air receiver 18 inches by 4 feet 6 inches is suspended beneath the truck and between the axles. A gasoline tank with a capacity of about 30 gallons is hung from the truck in the rear. The entire machine runs on steel wheels. The total weight of this compressor outfit is 8,500 pounds. It has a wheel base 7 feet long, with a tread of 5 feet.



PORTABLE AIR COMPRESSOR.

MOUND BELT PUNCH AND AWL.

It is not always convenient to punch holes in a belt with the ordinary style of belt punch, especially in large belts. Even if it were, it would take time to do so as the holes would have to be punched several times in order to obtain a hole of the proper size, and time is frequently a matter of dollars in making repairs to large belts.



BELT PUNCH AND AWL.

The Mound belt punch and awl is a tool which will appeal to engineers because it is convenient to operate and with it any size hole can be cut from ⅛ to 7-16-inch, regardless of the size of the belt.

In the illustration the blade is shown at *A* and the tool complete is shown at *B*. The blades are made of extra quality steel carefully ground and tempered. The handles are of polished nickel plate. This tool is manufactured by the Mound Tool and Scraper Co., 710-712 Howard street, St. Louis, Mo.

How the Priming was Stopped.

The following is an extract of a letter written by E. A. Suverkrop to the *Marine Review*. The engine crew had been telling about experiences with foaming boilers until the writer, who was third engineer, young and green, could think of nothing else. That night while standing his watch in the engine room of the little steamer he heard a loud bang. He says:

"I had almost recovered my nerve again when there was another bang, this time louder than before. I was all alone in the engine room and I hadn't the faintest idea what to do so I stuck my head in the stoke hold and called my fireman. He had been years at sea and I had heard him say he had been donkeyman. He no sooner got to the door than there was another long bang.

" 'What do you thing that noise is, Hanlon?'

" 'It sounds like as if she was primin', sir.'

" 'What's the best thing to do?'

" 'Oh, shut your throttle a bit and I'll let the steam go back a little.'

"So I shut the throttle a bit and he let the steam go back, but without result. The banging becoming more frequent and violent at last I could stand it no longer, so calling Hanlon to stand by the engines I darted up the engine room ladder to tell the chief.

" 'Mr. Morrison, she's priming terribly' said I.

" 'How do you know?' said he.

" 'Oh, every now and again she gives a series of terrible bangs as if she were going to burst the cylinders.'

" 'Is there any signs of foaming in the gage glasses.'

" 'No, sir.'

" 'What have you done to stop it?'

" 'I've let the steam pressure drop and shut the throttle a little. Is there anything else you would advise me to do, sir?'

" 'Yes. Hook back the engine room door.'

"And as if to emphasize his words the steel engine room door swung, by the motion of the ship, with a loud bang against its steel frame."

NEW BOOKS.

"Cams" and the principles of their construction, by George Jepson, D. Van Nostrand Co., 23 Murray street, New York, N. Y., 59 pages, illustrated, 6 x 9, cloth, price $1.50.

This volume describes the process of laying out a cam of any desired shape. The book is well illustrated and the explanation which accompanies each illustration is clear and comprehensive. Several halftone illustrations give the reader a very good idea as to how cams are turned up in a machine. The book is interesting and instructive.

"Mannheim and Multiplex Slide Rules," by L. W. Rosenthal, Eugene Dietzgen Co., 131 Monroe street, Chicago, Ill., 59 pages, illustrated, size 4 x 7 inches, paper.

This book is devoted to the description of the Mannheim slide rule and the Multiplex slide rule. The operation of solving problems by means of these rules is explained in this book. Part one consists of an introduction, the theory of logarithms, mechanical construction, notation of scales, multiplication, division, proportion, powers and roots; inverted slide, combined settings, scale of sines, scale of tangents and scale of logarithms. Each head has several sub-heads and the matter is most instructive and valuable to those who are interested in shorter methods of calculation. The second part contains practically the same matter only it is in relation with the multiplex slide rule. This is a calculating instrument of many uses, offering a convenient means of more rapid working, and securing greater accuracy at the same time. It not only solves all of the arithmetical, trigonometrical and logarithmic examples which are possible with the Mannheim rule, but possesses the following advantages: Multiplication of three numbers in one setting, division of one number by two numbers in one setting, more convenient solution of inverse proportion, direct solution in a single setting of a series of divisions with a constant dividend, direct reading of cubes and cube root, direct reading of three-halves and two-thirds powers and last, the direct solution in a single setting of many combined operations which require the slide rule to be shifted with the first mentioned rule.

NEW CATALOGS.

A CIRCULAR and price list briefly describing and illustrating the Bonar balance valve has been sent us by Jas. Bonar & Co., Frick building, Pittsburg, Pa.

"COMPRESSED AIR DISPLACEMENT PUMPS" is the title of a handsome booklet being distributed by the Ingersoll-Rand Co., 11 Broadway, New York.

IN THEIR ADVERTISEMENT the Lunkenheimer Co., Cincinnati, O., call attention to their new catalog. All who desire a copy should fill out the blank in the advertisement and mail as requested.

"CONTROL APPARATUS AND TROLLEYS for Single-Phase Railway Systems," manufactured by the Westinghouse Electric & Mfg. Co., Pittsburg, Pa., are described in circular No. 1127, issued in November.

THE DECEMBER ISSUE of the *Publicity Magazine,* which is published by the Under-Feed Stoker Co., Marquette building, Chicago, has been received. The publishers will be glad to send a sample copy to any one requesting it.

WE HAVE RECEIVED a catalog from the C. Lee Cook Mfg. Co., Louisville, Ky., devoted to their metallic packing. As this packing was used in the New York subway engines, many of our readers will doubtless be interested in it.

A BOOKLET of 25 pages describing the construction of Hancock valves, illustrating the various parts and different types and setting forth their advantages has been sent us by the Hancock Inspirator Co., 85 Liberty street, New York.

A VERY INTERESTING and instructive booklet telling about the use of fire-brick for boiler settings, stokers, etc., has been issued by the Harbison-Walker Refractories Co., Farmers' Bank building, Pittsburg, Pa. Mention this publication when writing.

A CATALOG issued by the International Boiler Works Co., East Stroudsburg, Pa., has been received. The catalog is a handsome one and illustrates to advantage the different types of boilers they build. The company also do a general plate metal business.

THE NEW CATALOG of the Austin Separator Co., 90 Woodbridge street, Detroit, Mich., contains much matter of interest and value to engineers. As this company manufacture all kinds of separators it is useful on that account. Ask for catalog No. 15.

THE FISHKILL Corliss engine is fully described and illustrated in the catalog recently received. The catalog contains 40 pages, 6 of which are devoted to a list of users, which is quite extensive. The engine is built by the Fishkill Landing Machine Co., Fishkill-on-the-Hudson, N. Y.

WE HAVE RECEIVED a booklet describing the Carb-Ox system. This system refers to smokeless firing and consists of a special furnace. As the patents are pending no detail drawings are given. For further information address the Carb-Ox System, 601 Hartford building, Chicago.

THE LATEST CATALOG of the Direct Separator Co., Syracuse, N. Y., describes their specialties. They manufacture steam separators, oil separators, ammonia separators, exhaust heads and steam traps. Their exhaust heads are patented by Prof. John E. Sweet and the traps by Wm. T. Powers.

A HANDSOMELY printed and illustrated folder has been sent us by the Bates Machine Co, Joliet, Ill. It describes the Bates vertical high speed engine for either belted or direct connection to generators. This engine is built in sizes ranging from 25 to 100 horsepower. Correspondence is solicited.

THE NATIONAL SUPPLY CO., 315 Dearborn street, Chicago, Ill., manufacturers of the Billow system fuel oil appliances have sent us a copy of catalog C which they have issued. As oil is coming more and more into use as a fuel and has shown very satisfactory results, engineers should be interested in this subject.

THE GEO. W. LORD CO., 2238-5 N. Ninth street, Philadelphia, Pa., offer a New Year's present to every engineer who fills out the blank in their advertisement and mails it to them, together with a piece of scale taken from his boiler. They do not say what the present is, but assure engineers that it is worth having.

"CENTRIFUGAL PUMPS" is the title of a 50-page catalog sent us by the G. W. Price Pump Co., 523 Market street, San Francisco, Cal. Besides centrifugal pumps this company also make power and deep well pumps, gas and oil engines and crude oil gas generators, etc. They will be glad to give information on any of these subjects.

A HANDSOME SOUVENIR book known as Kings Views of New York is being sent out by the Strong Machinery & Supply Co., 48 Franklin street, New York. It is printed on heavy coated paper and contains hundreds of illustrations of the Metropolis with appropriate descriptive matter. The supply is limited. First come, first served.

THE DIFFERENT TYPES of gas engines and their construction as well as complete information regarding them, are shown in printed matter received from the Bruce-Meriam-Abbott Co., Cleveland, O. These engines present a handsome appearance and are said to be ideal prime movers for small electric lighting and manufacturing plants.

THE DECEMBER issue of *Graphite,* which is published monthly by the Jos. Dixon Crucible Co., Jersey City, N. J., contains the second chapter of "Steam and Return Pipes for Heating Systems" by W. H. Wakeman. Besides this there are a number of other articles of interest to engineers, most of them relating to lubrication, paint, etc. *Graphite* is sent free to engineers.

THE PENBERTHY INJECTOR CO, Detroit, Mich., will be glad to place their new catalog, which describes all their specialties, in the hands of every engineer. They have made a special effort to make this attractive and interesting. Some engineers make catalog cases so as to file their catalogs for ready reference. This is a good idea. Catalogs contain lots of valuable information.

GREENE, TWEED & CO., 17 Murray street, New York, are distributing a calendar for 1906 which will doubtless be desired by every engineer. Its design consists of several strands of Palmetto packing arranged in an artistic manner. They will be glad to furnish one of these calendars to any engineer desiring one. All you need do is to write them a postal requesting the calendar. It will be forwarded immediately.

A NEW EDITION roller map, 60 by 40 inches in size, showing the United States from the Great Lakes to the Pacific Coast. All railroads are shown in different colors and characters. All geographical points west of the Missouri River and practically all east thereof are included. The most complete reference map of the West ever published. It ought to have a prominent place in every office and business house. Copies sent free for 25 cents (stamps will do) to pay transportation, etc. Address, P. S. Eustis, Passenger Traffic Manager, 209 Adams street, Chicago, Ill.

WE HAVE JUST RECEIVED from the Lagonda Mfg. Co., of Springfield, O., their new 36-page catalog, which fully illustrates the different types of tube cleaners which they manufacture, and shows cuts of the different machines at work in different types of boilers. It shows not only their turbine machines, but two types of power cleaners, also their reseating machine, damper regulators and tube cutters. We notice, too, a new type of turbine cleaner which they have recently brought out. It is style No. 14. The Lagonda people have had long experience in the manufacture of tube cleaners and their familiarity with the subject makes it possible for them to produce machines which they claim are unequaled for removing scale from boilers. They solicit correspondence with any one interested in this line.

TRADE NOTES.

A GOLD MEDAL was awarded the Myer's power pump at the Lewis & Clarke Exposition. This pump is manufactured by F. E. Myers & Bro., Ashland, O.

THE TRILL INDICATOR CO., Corry, Pa., manufacturers of Triumph indicators and Faultless reducing wheels, etc., have recently moved into their new quarters on East South street.

THE ROBB-MUMFORD BOILER CO. announce their removal from Cambridge, Mass., to their new plant at South Framingham, Mass. All correspondence should be directed to the new address.

THE WALTER L. FLOWER FILTER CO., formerly located at 1011 Chemical building, St. Louis, Mo., have moved into the Cupples block at 312-314 South Eighth street, same city. They thank their friends and patrons for the business that made this change necessary.

THE PENNSYLVANIA RAILROAD is equipping many of its new shops with heating and ventilating apparatus furnished by B. F. Sturtevant Co., Boston, Mass. Among these buildings are the pattern shop and soft iron foundry, South Altoona, Pa., and the steel car paint shop at Enola, Pa.

THE RUSSELL ENGINE CO., Massillon, O., have engaged Mr. W. N. Clifford as salesman with office in the Oliver building, Boston. Mr. Clifford was formerly with the Shepherd Engineering Co. They have also opened an office in the Monadnock block, Chicago, with H. S. Walker as manager.

THE WESTERN TUBE CO., Kewanee, Ill., desire to bring the Kewanee union, which has a number of advantages, to the attention of engineers. In order to do this they will send free of charge a sample union and their catalog to every engineer writing them, giving his name, address, occupation and name of employer, and mentioning the Engineers' Review.

: MECHANICAL RUBBER CO., 72 Lisbon street,
ınd, O., now have a complete line of packings and have
d "Marco" for their trade mark. Any engineer who can
why "Marco" was taken as the trade mark and sends his
to the Mechanical Rubber Co. at the above address will
t, free of charge, a briar pipe. Their new catalog will
soon and every engineer should have a copy.

: WESTINGHOUSE ELECTRIC & MFG. CO. have
y renewed an annual contract covering the requirements
Moline Elevator Co., Moline, Ill., so far as their motor
are concerned. The renewing of this contract is due to
ghly satisfactory performance of Westinghouse elevator
under the most trying conditions, their design and con-
on rendering them peculiarly adapted to the requirements
severest elevator work.

: FOSTER ENGINEERING CO. of Newark, N. J., re-
cent sales of pressure regulators and other valve special-
follows: For Vienna, Austria, 160 pressure regulators,
rted sizes up to 4-inch; for Albany, N. Y., sixty pressure
ors, assorted sizes; for National Tube Works, two 14-
ressure regulators; for United Electric Light & Power
Louis, Mo., fifty-four 5-inch and 6-inch automatic non-
valves; for American Steel Co., sixteen 6-inch combina-
nergency stop valves; for Olympia Cotton Mills, Colum-
C., twelve 8-inch pressure regulators.

ERT VOGT, M. E., with J. M. Voith, Heidenheim,
ny, made a test of Albany grease while in this country
y at Niagara Falls, N. Y., and in a letter to Messrs.
Cook's Sons, 313 West street, New York, the only mak-
ys: "I used your Albany grease on the turbines of the
Power Co., Niagara Falls, Ontario, and not only on
arings, but also for greasing the bearings of the regulat-
es. These bearings are under hydraulic pressure and it
ery great importance that the right kind of grease is
I can assure you that your Albany grease has given very
tory results."

NG THE MORE IMPORTANT sales of the White
l filters by the Pittsburgh Gage & Supply Co., Pittsburgh,
ring October were: Nineteen, through Philadelphia and
ork houses of the Vandyck-Churchill Co.; 6, through
egg Engineering Supply Co., Cincinnati; 4, through the
y Supply Co., New Orleans; one of the complete White
iling systems sold during the same month was a third
ught by the People's Power Co., Moline, Ill. Frequency of duplicate orders is always a fair measure of the popularity and value of any commercial device, and by this token there can be no doubt of the merit of the White Star filter and oiling system.

THE WILLIAMS GAUGE CO. have reported the sale, within the last six months, of 520,000 horsepower safety feedwater regulators. Among the purchasers are the Philadelphia Rapid Transit Co., Illinois Central Railroad, New York Central and Hudson River Railroad, Delaware & Hudson Co., the Erie Railroad, Proctor & Gamble, Carnegie Steel Co., American Steel & Wire Co., etc. The demand for this regulator is increasing wonderfully. The claims made for it by the above company, substantiated by the experience of its users are, that it will produce a fuel economy of from 4 to 12 per cent, a guaranteed assurance of dry steam constantly, and increased boiler efficiency. It is used on about 3,500,000 horsepower in the largest plants in the country, and has been on the market for upwards of seven years. This company also manufacture a steam operated trap, which they claim is the only trap with a valve which gives a full pipe opening instantly.

FANS, BLOWERS AND EXHAUSTERS for heating and ventilating, mechanical draft and other purposes are described

Are you having difficulty in keeping your boilers clean and free of scale?

International Boiler Compound

Is the thing you've been looking for. Write for our special proposition to engineers.

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"MARCO"

Ve Have Adopted This Trade Mark For All Our
'ackings. —— Can YOU Guess WHY?

We will give 500 Briar Pipes to the 500 Running Engineers who first send correct answers with their firm name, position, own name and address. —— Guess NOW!

3y the way — Our New Packing Catalogue will help
ou guess. —— Write for it! —— Write NOW!

The Mechanical Rubber Co.
72 Lisbon Street
Cleveland, Ohio

A New Austin Catalogue

Number 15 Now Ready

WE hope every steam user and engineer will get placed on our list to receive a copy. Certainly it is worth writing for and twice worth reading.

The entire Austin line of

Steam and Oil Separators
Standard and Receiver Patterns
Separators for Vacuum Service
Compressed Air, Gas, Etc.

are illustrated and fully described, with particular reference to special conditions in different plants.

We have written this Catalogue for the practical, every-day engineer, with as few technicalities as possible in its pages.

In plain words, it tells how and why separators should be used;

Their proper selection;

The fitness of our various patterns for different conditions of service;

A little concerning the theory of separation; and much more about the practical construction of Austin Separators to secure perfect elimination of moisture from live steam, and the extraction of oil and impurities from exhaust.

If you would like a copy, write us today.

Austin Separator Co.

90 Woodbridge Street
Detroit, Mich.
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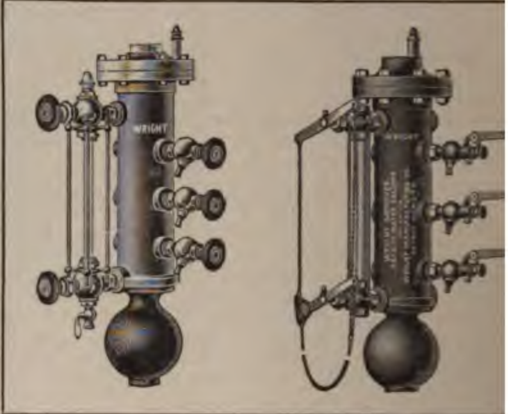
Hints to Young Engine Under Eighty



A point about the Wright Improved Safety Column that we particularly recommend is the FL That is the busiest part of an alarm column and the most wear.

Problem: How to make f long-lived.

Our floats are made of copper, seamless and because a round float is much stronger than an one—the steam pressure upon it being equalized.

A strong float, fewer working parts, and those simplest possible construction, are the basis of ou that

Wright Improved Sa Water Columns give longer service and need less attention for repairs than any other.

Our CATALOGUE gives full details, explains the advantages of fuel-saving, dry steam, prevention of leaky tubes, etc., secured by the use of these columns, together with the protection they afford to life and property. Write for it.

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This Knife FREE

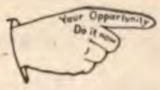
CUT OUT—A SAMPLE OF SCALE FROM YOUR BOILER, THEN
CUT OUT—THE COUPON AND MAIL IT TO US WITH THE SCALE.

Then we will send you—free of charge—a high grade pocket knife—two blades—actual size of illustration; also some information regarding

Lord's Boiler Compounds

and how they remove scale. The superiority of our products is proven by the growth of our business. We now operate the largest plant in the world devoted to the analysis of scale and the preparation of water purifying chemicals.

CUT OUT—the extra work caused by scale.
CUT OUT—burning too much coal.
CUT OUT—experimenting with ready-made boiler compounds
CUT OUT—and mail this coupon today.



**The
Geo. W.
Lord Co.
2238-50
N. 9th Street,
Philadelphia, Pa.**

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, and send me, free of charge, a certificate of analysis and the knife.

Number of boilers in use ______
Capacity of each boiler ______
Frequency of cleaning boilers ______
Frequency of opening the blow-off during working hours ______ *River or other source of water supply* ______
Boilers are used about ______ *hours out of 24*
Boiler compound now used ______
Name ______
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City ______ *State* ______
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VACUUM OILS

Are known and used in every corner of the world where machinery runs. They are the standards of value throughout the whole world; they lubricate every kind of machinery; not the same oil for all machines, but the right oil for each class.

They are made to fit every condition and are used everywhere because they are the best.

Once used VACUUM OILS are always used.

These oils are made at Rochester and Olean, N. Y., and are distributed throughout the world from local branches.

Abroad they are distributed from ***one hundred and twelve foreign warehouses*** and at home they are sold in every city.

VACUUM OILS

reduce friction to the limit, thus saving power. They are always uniform; can always be depended upon. They do their work better than other oils and cost less when the amount of work done is considered.

VACUUM OIL COMPANY

ROCHESTER, N. Y.

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This Trade Mark on every package

There is only **ONE ALBANY GREASE**

AND WE ARE THE ONLY MAKERS.

Lubricates Everything. Adapted to All Kinds of Machinery.

Can be used in every style of grease cup made, which cannot be done with *any other* lubricant.

Cost of using Oils ▬▬▬▬▬▬▬▬▬▬
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We solicit your inquiries. We guarantee satisfaction. Good goods are cheapest in the long run. Write us or call and see us the next time you are in New York.

Our Special Offer.
A sample can of Albany Grease and an Albany Grease Cup, free of charge, for testing. The only information necessary to send, is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

ADAM COOK'S SONS,
313 West Street, NEW YORK CITY, U. S. A.

GRAPHITE LUBRICATION

Sound in its theory
Wonderful in its practical results

DIXON'S Ticonderoga Flake **GRAPHITE**
is a boon to engineers.
Valuable booklet No. 164-C and test samples free.
Joseph Dixon Crucible Co., Jersey City, N. J.

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The BURROWS BROTHERS COMPANY,
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Send for
Nugent's Valuable Treatise on
How to Oil an Engine
and large Catalog of new and *up-to-date Oiling Devices* for *Hot* Members.
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THE MAN WHO BUYS PUBLICITY

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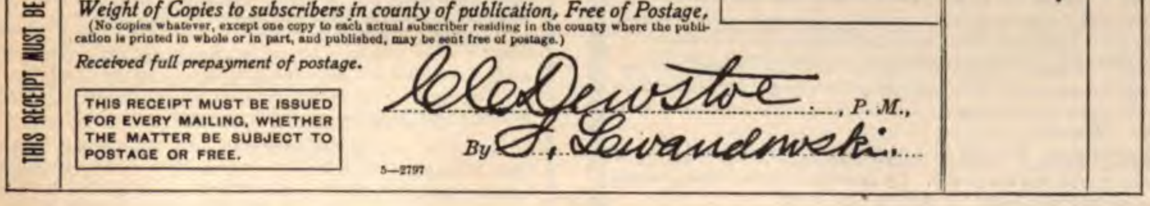

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No. 73 A
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Date, Jan 19, 1906
Name of Publication, Engineers Review
Or News Agent,

POUNDS MAILED.

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Weight of Copies to Subscribers, Subject to Postage, 11938
Total weight of Copies subject to postage at One Cent a pound or fraction thereof. $ 119.38
Weight of Copies to subscribers in county of publication, Free of Postage,
(No copies whatever, except one copy to each actual subscriber residing in the county where the publication is printed in whole or in part, and published, may be sent free of postage.)

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C. C. Dewstoe, *P. M.*,
By S. Lewandowski

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5—2797

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One copy of Jan. issue wrapped weighs 9.55 ounces, making a total number, mailed at the pound rate, of	20,000 copies
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Which contains nearly 700 pages of the knowledge you will have to have to pass a successful examination. $3.50 Money back if not satisfied

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THEO. AUDEL & CO., 63 FIFTH AVENUE, NEW YORK

Please mail me Complete Catalog and terms of the Hawkins' Engineers' Library.

Name ....

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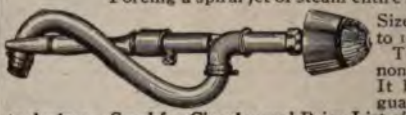
Cleveland Flue-Cleaner Manufacturing Co.

Forcing a spiral jet of steam entire length of tube.



Sizes to fit any boiler, w
to 16-in. tubes. A. & D.
The old reliable and m
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It has no equal. Sati
guaranteed. Liberal d
to dealers. Send for Circular and Price List of Cleaner and Hose.

Room 13, 74 Frankfort Street, CLEVELAND,

If you are in need of machinery or supplies r
to the Buyer's Directory on page 58.

IT'S FUN TO CLEAN BOILERS

WITH A DEMON OR WITH A TORPEDO

THE "DEMON"
REMOVES ALL SCALE FROM TUBES OF WATER TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/16 INCH OF SCALE
IS 42 TIMES AS POWERFUL AS TURBINE CLEANERS
DOES NOT HAMMER OR GRIND BUT CUTS AND CRUSHES
CENTERS ITSELF AND CUTS SAME TOP, BOTTOM & SIDES
ADJUSTABLE CUTTER STOPS PREVENT INJURY TO TUBES
ROTARY PISTONS ARE ACTED UPON BY DIRECT PRESSURE AS IN STEAM ENGINE
HAS ROLLER BEARINGS

Maybe you are in the habit of thinking the cleaning of your water tube boilers is an everlasting and detestable nuisance. So it is with most cleaners, but a trial of a "**Demon**" would soon show you how to get through the work quickly, easily, and without exhausting your patience.

The "**Demon**" is a "get down to the iron" cleaner. It is so adjusted and constructed that it **must** remove **ALL** scale as it goes along, and it is the only machine in the world that will do this.

The "**Demon**" positively cannot pass over scale, and the operator cannot force it through the tube without taking the scale off right down to rock bottom. In short, it is a real pleasure to operate the "**Demon.**"

The "**Demon**" is able to do this perfect and wonderfully rapid work because it has the power. By actual test, it develops 42 times the power of a turbine.

If you believe in having the best cleaner in every way that was ever invented, then let us send you a "**Demon**" on free trial. Our catalog "E" tells more about it.

THE "TORPEDO"
REMOVES ALL SCALE FROM TUBES OF FIRE TUBE BOILERS
SAVES 20% OF FUEL FOR EACH 1/16 INCH IN THICKNESS OF SCALE
PROLONGS LIFE OF TUBES
SAVES COMPOUND
CENTERS ITSELF IN TUBE
STRIKES SAME IN EVERY DIRECTION
STROKE IS LIMITED AND CUSHIONED
DOES NOT HAMMER BUT VIBRATES THE TUBE
IS ABSOLUTELY SAFE AND EASILY OPERATED
HAS BUT ONE MOVING PART
WILL LAST A LIFETIME

Take a look at your fire tube boilers and see how foolish it is to attempt to clean the water side of the tubes by going inside the boilers with a hammer and chisel. Fully 90% of the heating surface is beyond human reach.

Hitch up a "**Torpedo**" and watch the scale fly. You stay outside the boiler and let the "**Torpedo**" do the hot, dirty work.

It requires only about 5 minutes to each tube, and when your boiler is clean, you need not bother washing it out every week. It saves the engineer's time and patience. It saves the boiler tubes and increases the steaming capacity of the boilers. It saves the firm hundreds of dollars in fuel, every year.

All other fire tube cleaners operate on the hammer principle. The "**Torpedo**" vibrates the tube instead, which renders it harmless but makes the scale fly like snow flakes in a winter's storm.

Take a "**Torpedo**" on free trial, and see for yourself. If you don't like it, don't keep it. You are the judge. Write to-day giving size of tubes.

THE GENERAL SPECIALTY CO., 73 Carroll St., Buffalo, N.Y., U.S.A.

E WHITE STAR OIL FILTER

pays 100 per cent quarterly dividends.

It thoroughly purifies dirty lubricating oil, rendering every dollar's worth fit for use over and over again.

It is a necessity in every
ver plant, a paying investment from
start. Unlike any other Filter it
be quickly taken apart and cleaned.

Vital facts pertaining to the purification of dirty lubricating oil, results attained by the White Star, also list of prominent users are shown in Booklet "J" which we will be pleased to mail you.

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PITTSBURGH, PA.

OIL FILTRATION EXPERTS.

LEY'S Hot-Blast Flue Cleaner
AGENTS WANTED.

, time and money saving necessity. Guaranteed to clean flues
s hotter than the boiler. No cold air or wet steam. Leaves
n the flues. The suction and blowing principle balance the
It makes no dirt in the room. Sold on approval. **Risley's**
back-arch saves 5 per cent of fuel. Write for catalogues
plain details.

THE RISLEY MOSER CO., Princeton, Ind.

tning Tube Cleaner" Features.

-Cleans scaled tubes inside or outside.
-Propelled by water, air or steam.
-Does the work quick.
-Saves $2.00 every 10 hours run metered water bill.
-Motor Wheel utilizes a compound power.
-Construction overcomes cone and ball breakage.
-Has re-sharpening, non-breakable cleaner head.
-Future repairs, very small item.
-Price saved several times a year in coal bills, and it lengthens the life of the tubes many years.

pproval. Attractive proposition to State Agents.

AURER, LABADIE & CO.
Joe Street, South Bend, Ind.

An engineer consults his own and his employer's interests and demonstrates his value in the engine room by using

Harris Oils

To prevent friction, destruction of wearing parts, loss of power and money in operation of a plant, the engineer depends on lubricants.

Their quality and fitness for the purpose for which they are used, determines the efficiency of engines and machinery.

For this reason many competent engineers use exclusively

Harris Oils.

Embracing lubricants adapted for every purpose, they are the result of many years' careful study of the requirements of different types of engines and classes of machinery.

The wear to which each is subject, the working pressure and prevailing temperature, to which they are exposed, are studied in their composition, ensuring in every instance, the best results.

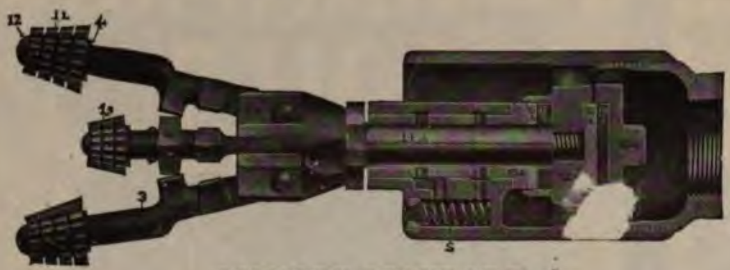
A Harris catalog, gives detailed information concerning these reliable lubricants and can be obtained for the asking.

A. W. Harris Oil Company

321 South Water Street
PROVIDENCE, R. I.

Tatum & Bowen, 36 Fremont St., San Francisco,
Pacific Coast Agents.

THE LIBERTY STANDARD CLEANER



LIBERTY STANDARD

has satisfactorily solved the tube cleaning problem by cutting out that expensive repair account, saving all that expensive bench work in adjustment, cutting down the time required to clean a boiler, all of which the boiler users appreciate. The demand for the ***Liberty Standard Cleaner*** since we put it on the market has been enormous and shows that its design and construction is appreciated by those who have had experience and are capable of judging.

The ***Liberty Standard*** is built for ordinary service.

For heavy service, the ***Liberty Heavy Duty*** is recommended.

In a competitive test made a short time ago with the ***Heavy Duty Liberty*** in competition with a power machine, the following were the results with the scale ranging in thickness from ½" to ¾", both machines working on the same boiler for the same length of time.

The number of tubes cleaned by the so-called power machine, eight.

The number of tubes cleaned by the ***Liberty Heavy Duty,*** twenty.

Either one of these machines ought to interest you if you want to clean your boilers for less money than it is now costing you.

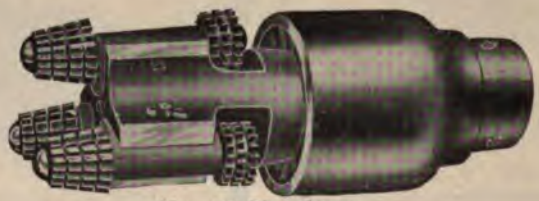
LIBERTY MANUFACTURING COMPANY,

4709 Susquehanna Street. PITTSBURGH, PA., U. S. A.

Weinland Tube Cleaners

The machines that "**do things**" to boiler scale without injuring tubes. We make all kinds Hand, Turbine and Power Cleaners. Sell them, rent them, or clean by contract. Any way you please.

More Weinland Cleaners in Use than



All other Turbine makes Combined

No. 14 Machine.

The Head is the "**business end**" of a cleaner. We make special types suited to special conditions.

This machine has met in actual combat and conquered every rival old and new. Try it yourself, that's the best argument.

We also make Tube Cutters, Damper Regulators and Reseating machines---all money savers.

But please remember WE are THE Boiler Cleaner People. Get our new 36 page catalogue.

THE LAGONDA MFG. CO., Springfield, Ohio

BOILER CLEANING EXPERTS—AT IT 20 YEARS

NEW YORK PITTSBURG PHILADELPHIA TOLEDO LONDON, ENG.

BEST IN THE WORLD

RUGGLES'
"Perfection" Flue Cleaner

LIGHT. STRONG. SIMPLE.

Built on practical mechanical lines of the best material money can buy.

The cutters are always in close contact with the metal of the flues. Knives are sharp, like a plane, and tendency is to work deeper all the time.

ENDS MADE OF DROP FORGED STEEL.

No screws and no rivets in its construction, and yet it is the **strongest** cleaner made.

EASY TO USE.
Does the Work Thoroughly.

Sold on absolute guarantee to do the work, or money refunded.

Write for 150-Page Stock List—its free.

SCULLY STEEL & IRON CO.
63-75 No. Halsted Street Dept. A. CHICAGO, ILL.

REX PACKING

THE ONE PACKING
THAT MEETS EVERY REQUIREMENT
OF THE ENGINE ROOM

Can be used on any piston rod, pump rod or valve spindle.

No Fitting, No Waste.

A fibrous, non-corrosive combination of metals, indefinitely durable. Cannot be set up tight enough to score or grip a rod. Its cellular structure ensures retention of oil, constant, perfect lubrication and reduction of friction.

5, 10 and 12 Pound Cans.
Sample package free on request
No charge if it fails to fulfill claims made

Walter L. Flower Filter Co.,
315 South Eighth St. ST. LOUIS, MO.

Let us Send You the Dean Boiler Tube Cleaner on Trial.

Our confidence in what it will accomplish for you is not only based upon what we know of the machine ourselves, but upon the endorsements that are constantly being received from the purchasers of the

6000 THAT ARE NOW IN USE

Remember that the Dean Cleaner will not only remove scale from the tubes of your boilers but will expose defects in the tubes and thereby avert disaster; it will bring your boilers up to the proper standard of efficiency. Just glance at it at work:

For Water Tube Boilers.

For Tubular Return Boilers.

Don't accept our word for it; let us send you our booklet "Boiler Room Economy" that gives the endorsements of some of the largest power-users in the country, every one of whom

FIRST ACCEPTED OUR FREE TRIAL OFFER

Remember that it will cost you nothing to make a trial of its merits in one of your boilers. You send us the size of your tubes and the Cleaner will be forwarded.

THE WM. B. PIERCE CO.,
325 Washington Street, BUFFALO, N. Y.

Why be contented with a Packing that has one or two good features when P. P. P. can be credited with TWELVE!

1 It reduces friction decidedly.

2 It lasts far longer than solid packings.

3 It lubricates itself.

4 It gives you no unnecessary trouble.

5 It prevents rod from binding or heating.

6 It fills in scores, and assists rod to work easily.

7 Succeeds where other packings fail.

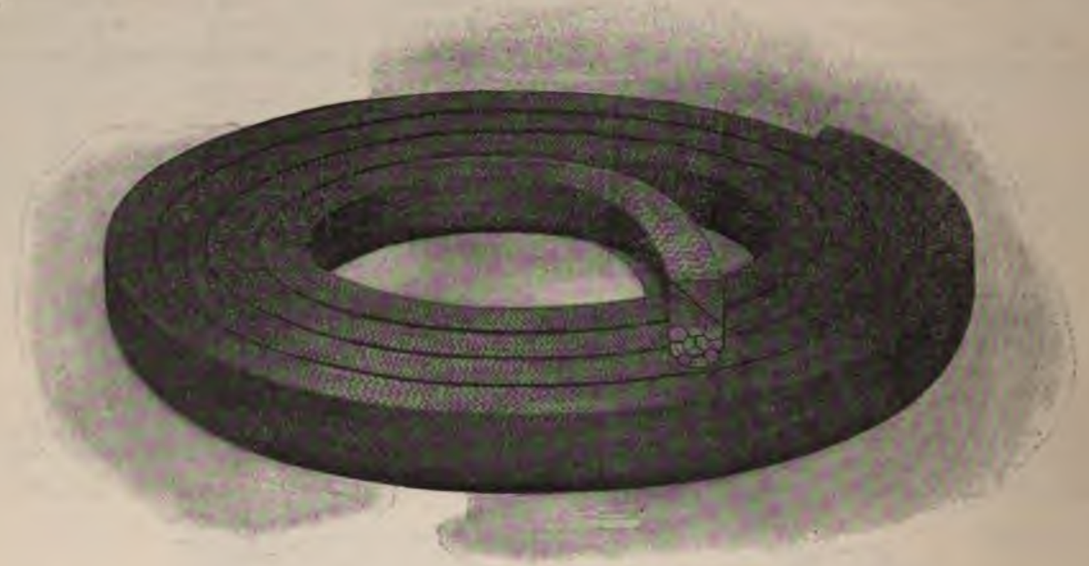
8 Saves from $104 to $250 a year per rod by saving power.

9 It does not become hard.

10 It saves you from having to pack the stuffing-box every little while.

11 It is not affected by steam, oil, acids, and alkalies.

12 An extra ring is all it requires when worn.



If the packing you use is not satisfactory—if it gives you trouble in one way or another—and soon wears out—try P. P. P. It will surely prove a great improvement. We know it will, for its special construction allows it to overcome the greatest difficulties.

WRITE DEPARTMENT "H" FOR OUR BOOKLET ON P. P. P.

QUAKER CITY RUBBER COMPANY
PHILADELPHIA, PENNA.

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WATER HOT or COLD AIR OXIDE AMMONIA	FOR	STEAM Moist or Dry Superheated Low Pressure High Pressure

PACKINGS

THE CLEVELAND RUBBER WORKS
OF THE MECHANICAL RUBBER CO.
72 Lisbon Street Cleveland, Ohio

WE HAND YOU READY FOR USE

CRANDALL PACKINGS

Our Catalogue tells how to select the right kind and the right size, that can be opened up and used at once without any preparing, on engine, compressor or pump.

No Waste, No Loss of Time

Crandall Packings

are specially made for all purposes and in all sizes. Thoroughly impregnated, by a special cold oil process with suitable lubricants, they wear well and reduce friction. Their permanent resiliency ensures a tight joint, without gripping or scoring a rod.

Style No. 65 for Cold Water Pumps and Plungers

These packings do not deteriorate through keeping. The engineer can safely keep them in hand for permanent or emergency use.

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Crandall Packing Co.

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New York Store
136 Liberty St.

Chicago Store
52 West Washington St.

Cleveland Store, No. 9 South Water St.
Pacific Engineering Co., Seattle, Washinton
Pacific Coast Agents.

HONEST JOHN HYDRAULIC RAINBOW CORE PACKING

You do not know what a high grade cold water packing is until you have used the "old reliable" HONEST JOHN.

Made spiral or ring form.

Be careful—there are many dis-honest imitations. Don't let any dealer make you believe that "all coons look alike" to him.

SUCCESS SEMI-METALLIC DIAGONAL EXPANSION SPIRAL PACKING RAINBOW CORE

Those engineers who fancy a combination packing will find the Success the best of them all. The most carefully constructed and highest grade combination packing on the market.

Write for sample.

Patented October 31, 1899

SUPERHEATED STEAM PLANTS

WIZARD RINGS, GASKETS AND WICKING

The manufacturers of the Celebrated Rainbow Packing after a series of experiments have succeeded in perfecting a packing in ring form for stop valves which will most successfully stand superheated or high pressure steam.

Write for sample of the Wizard Ring. The only gasket for superheated and high pressure steam is the Improved Moulded Wizard Gasket. Try it and be happy.

Manufactured, Patented and Copyrighted Exclusively by

Peerless Rubber Manufacturing Co.

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Dallas, Texas, 177 Elm Street
Memphis, Tenn., 228 Front Street

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THE SECRET IN THE MANUFACTURE

THE CLAIMS OF "WOULD BE COMPETITORS" TH
THEY KNOW THE FORMULA IS ABSOLUTELY FA

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G IS AS SAFE WITH US AS WITH THE SPHINX

BEWARE OF IMITATIONS
AND "SHODDY" SUBSTITUTES

TS SECRET, BUT IN ITS GREATNESS

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OUGHOUT THE ENGINEERING WORLD

EXCLUSIVELY BY
UFACTURING COMPANY
, NEW YORK

THE ECLIPSE SECTIONAL RAINBOW GASKET

Facsimile of a 6-inch Section of Eclipse Gasket Showing Name and Trade Mark imbedded.

The original and only genuine Sectional Gasket—manufactured from the Celebrated Rainbow Packing compound.

Owing to the fact that any size gasket may be made instantly without waste, the Eclipse gasket is especially valuable to the engineer. It is far more economical and less troublesome than the old style moulded rubber gasket.

Don't worry—order a box to-day.

¼ in. and ⅜ in. for Pipe Unions.
½ in. for Hand Hole Plates.
⅝ in. and ¾ in. for Man Hole Plates.

Beware of cheap tubings and worthless imitations. Be sure the name Eclipse is imbedded in the gasket at intervals of six inches.

If you have never tried Eclipse write to us.

PEERLESS SQUARE BRAIDED FLAX PACKING

After you have become disgusted with so-called flax packing (made from old jute rope) let us introduce to you a flax packing that is actually made from real, genuine flax.

Yes, the price is higher than "old rope," but when using the Peerless Square Braided Flax Packing the results are so satisfactory you feel like whistling and singing all day.

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Peerless Rubber Manufacturing Co.

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Memphis, Tenn., 228 Front Street

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Standard Oil Co.
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France Packing Co.

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We use the better kind of flax, the best rubber for the core, and we make it just as good as we know how.

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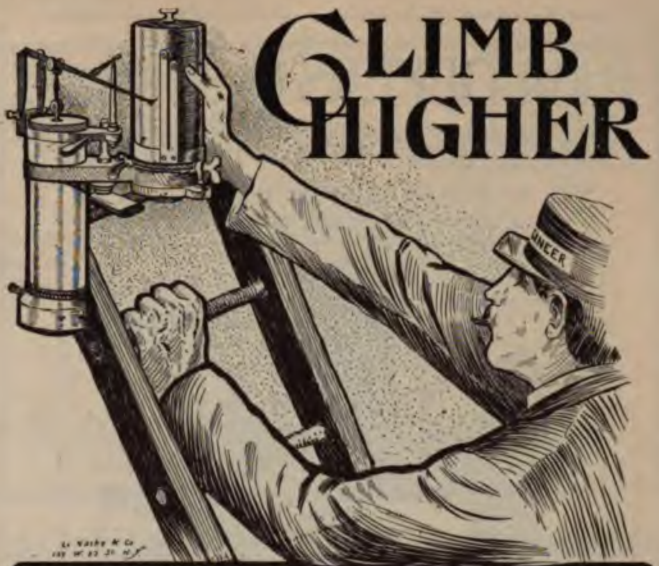

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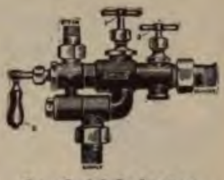

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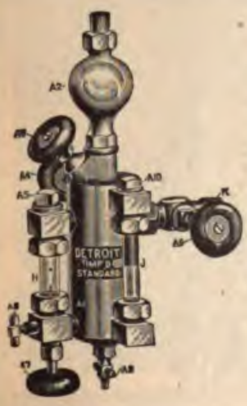

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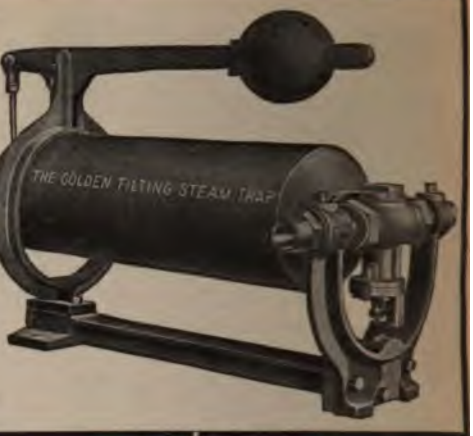
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The Anderson
CUSHIONED NON-RETURN VALVES

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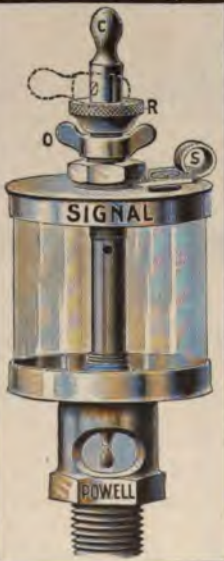

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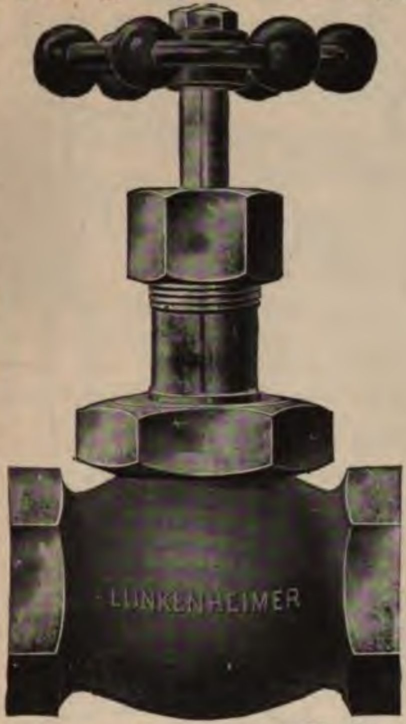

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THE mechanism of the steam end consists of two steam pistons, two steam valves and two valve guides. These are enclosed and are oiled from the lubricator—which we furnish. The wearing surfaces are as large in proportion as those on a first class Corliss engine.

Compare this with any other make of duplex pump, all of which have a steam mechanism consisting of a large number of small pieces which are exposed to dirt and grit, all difficult to oil, and have little or no wearing surface.

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For Draining Heating Coils, Etc.
Returns Water Direct to the Boiler.

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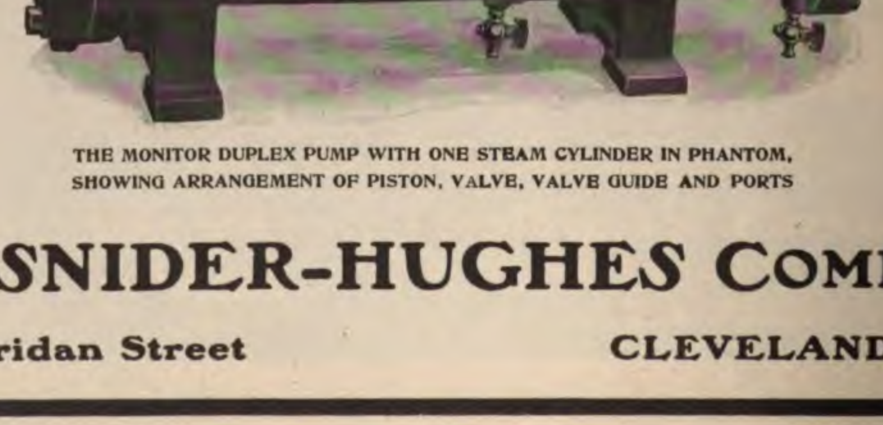

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That's the question. We've solved it in the perfection of the

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A COCHRANE Steam Separator in your steam line just ahead of the engine would save steam, save lubricating oil and insure better cylinder lubrication, because all of these things follow the use of *dry* steam in engines. These economies alone would pay for the Separator, and in addition you would have protection for your engine against any large flush of water that might come over, due to primage or foaming.

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ROTATIVE DRY VACUUM

PUMP

For use with high vacuum systems and steam turbine installations.

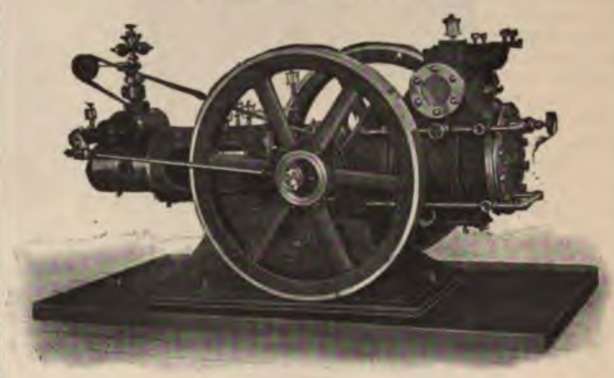

Illustration shows the compactness of this pump and it is just as effective and serviceable as it is compact.

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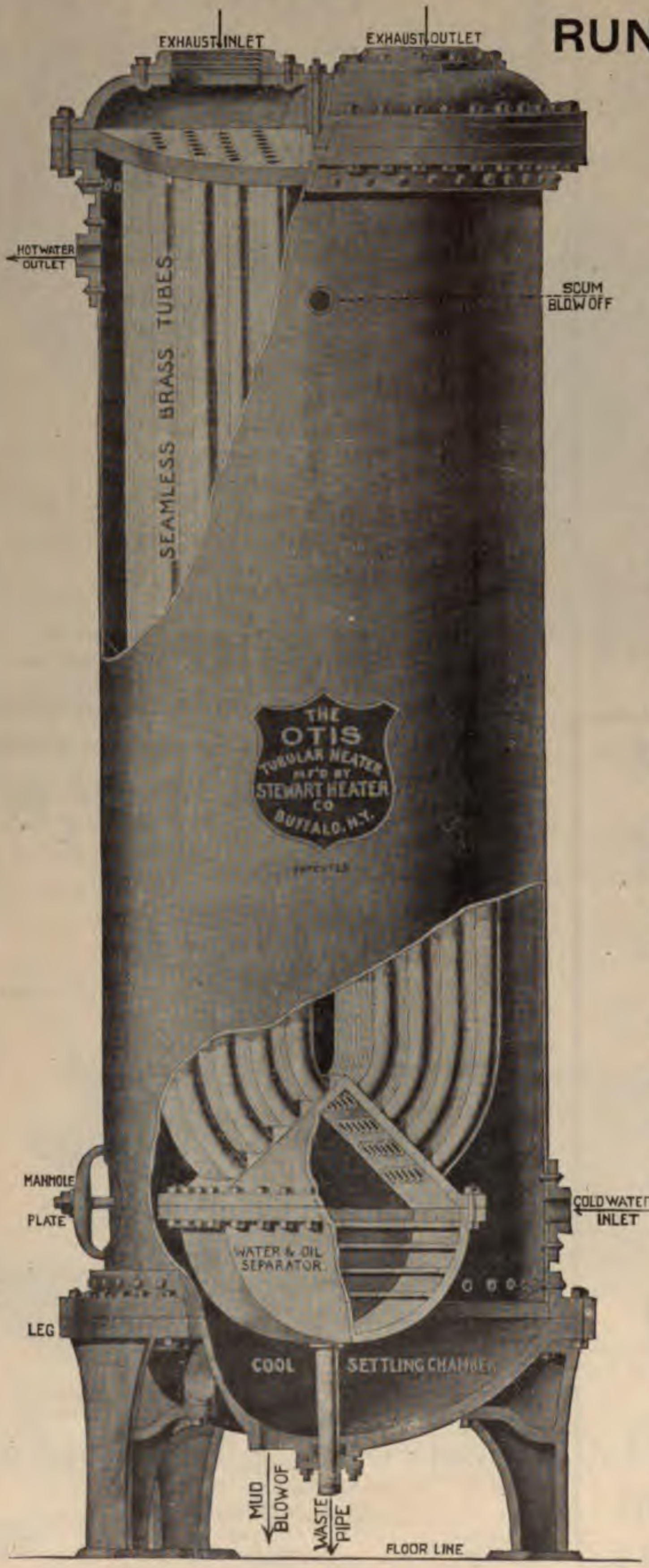

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Feedwater Heater, C
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is designed for and accomplishes t
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to heat the water to 210 or 212 degr
with exhaust steam without causing b
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THE NATIONAL FEED WATER HEATER

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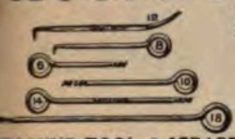

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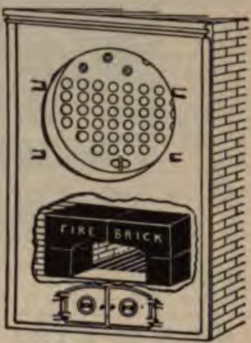

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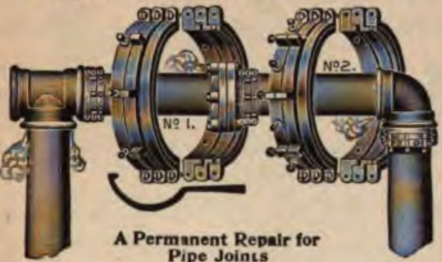

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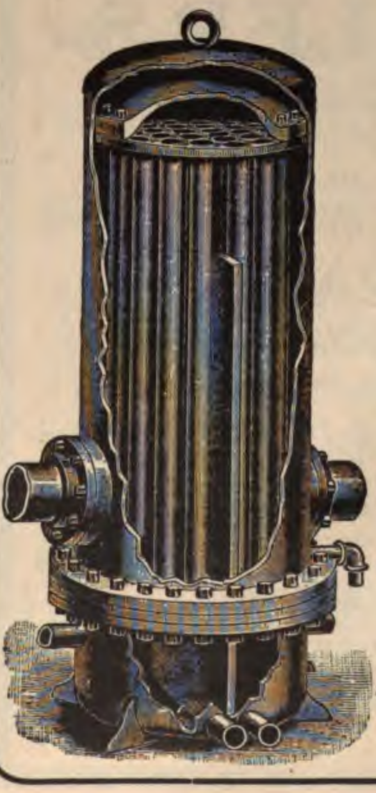

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The tubes being surmounted by a cap, forming a chamber at the top, and being fastened rigidly only to the lower tube plate, free play is given for expansion, thereby preventing rupture and leakage of joints.

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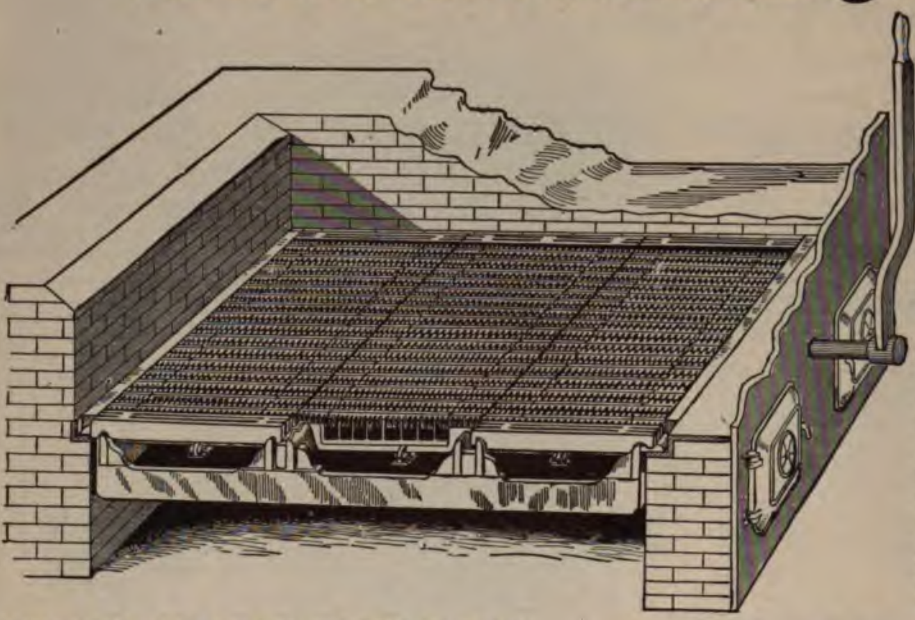
The Martin Rocking Grate



DOES not allow any fine coa to go into the ashpit. I burns it **all.** Will pay for it self several times over each sea son in the saving of fuel. **Pu in a trial set now.** Burn **any** coal and is especiall adapted for the cheaper grade such as slack and screening No change required in your fur nace. Anyone can set it in place

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For burning sawdust, wood, waste and bogarse

Rotary Blochers and Pulp Digesters, Penstocks, Wheel Cases, Standpipes, Forgings, Castings, Grates, Bolts, Gaskets and Boiler Fittings.

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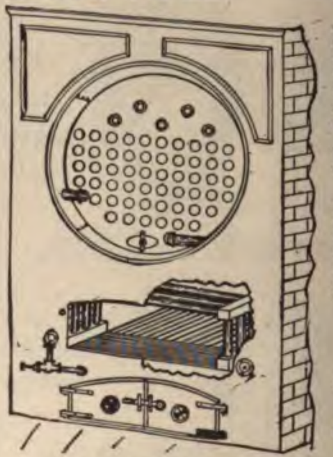
ARCH PLATES

SAVE FUEL. SAVE REPAIRS.



No burned out arches an cracked fronts if you use thi device for protecting boile mouths. Besides preservin the brickwork about the fur nace fronts, it saves fuel an allows the utilization of hea otherwise wasted.

SHAMROCK MILLS.
Winston-Salem, N. C., Jan 2
The Lamprey Co.

Dear Sirs: We have bee using for the past sixty day the Lamprey Protective Ar Plate which works to our e tire satisfaction. Were we t put in another boiler, w should be sure to use this d vice.

Yours truly,
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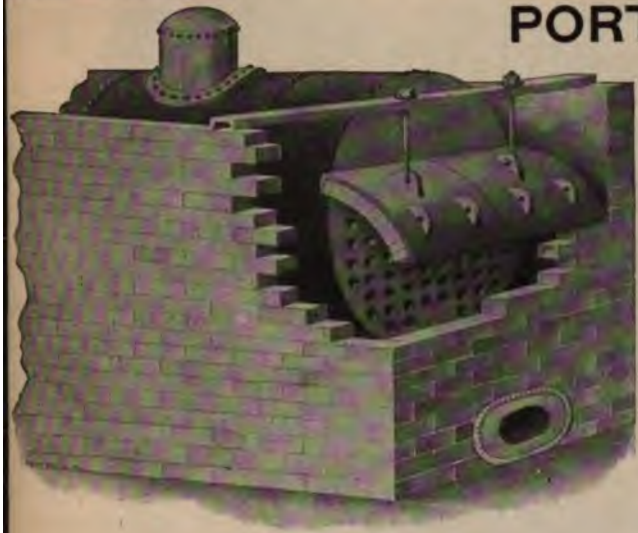

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Has the following advantages:

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The metallic arch is cast direct to the facing of fire brick, thus uniting them solidly without the use of bolts. The value of a portable arch of so durable a construction is certainly worth your careful investigation. ***Made to fit any boiler. Full particulars on request.***

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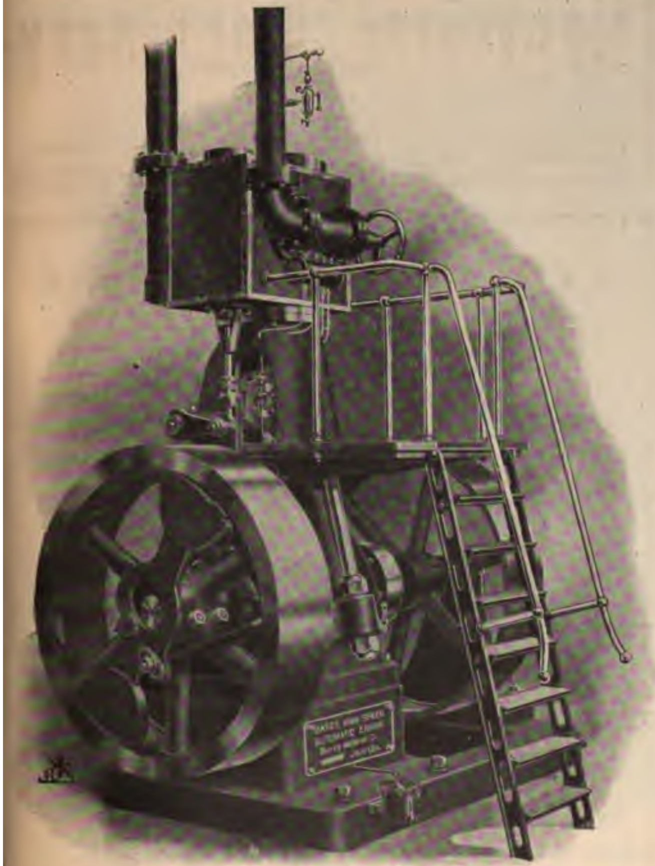

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Just what you need for Factory and Electrical Duty.

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This is the New and Improved Extra Heavy Duty

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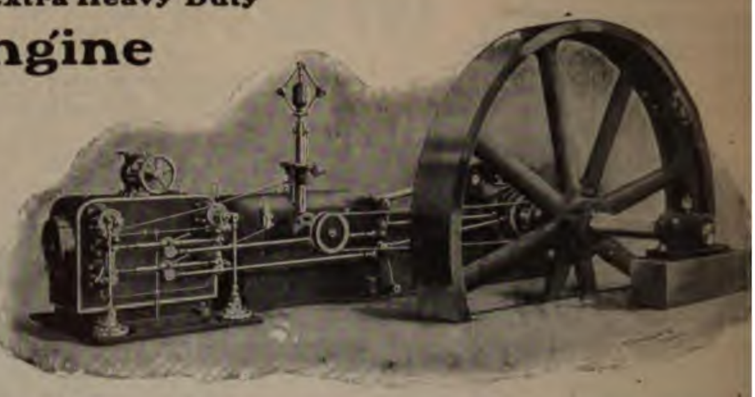
The latest and best as regards design and construction of stationary engines.

No wrist plates; double eccentrics; heavy one-piece frame; disc crank; noiseless vacuum dash pots and specially arranged Brown Patented Valve Gearing, with new and improved unhooking devices.

No matter what the duty—no matter what the power required, if you are going to purchase an engine you want the BEST. That means HARRIS-CORLISS. Built only by

Wm. A. Harris Steam Engine Co., Providence, R. I.



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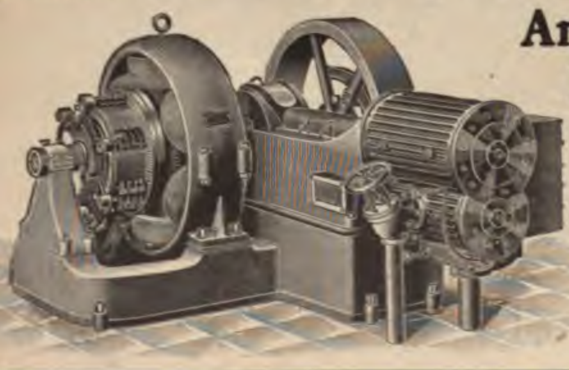

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